2005-06
Terry Husseman
Sustainable Public Schools Awards Program

Creative Environmental Curriculum

Curriculum Submitted by:

Komachin Middle School

Cover Page

Please complete this cover page and submit with your answers to the Application Questions.

Which award category do you want to compete in? *Check one category only!*				
☐ Seed Program	☐ Sustainable School Program		X Environmental Curriculum	
Grade Level				
☐ Elementary	X Middle/Junior	☐ Junior/Senior	☐ Senior	☐ K-12
Demographics				
Student Population #	785	Staff Population #	42 certificated staff	

Contact Information	
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School District	North Thurston Public Schools
Mailing Address	3650 College St. NE
City & Zip Code	Lacey, WA 98503
County	Thurston County
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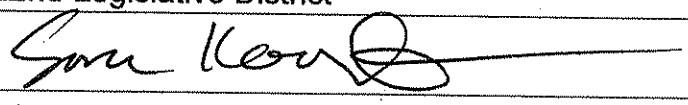
Legislative District #	22nd Legislative District
Signature	

Application Questions

Brief overview of Komachin Middle School

Komachin Middle School has taken an interdisciplinary approach to the study of Sustainable Communities since it first opened. We have identified indicators of sustainability and our students have studied them in different content classes. In math students have studied resource consumption. In social studies students have studied public participation. In language arts students have studied social harmony. Our science classes have tackled biodiversity as well as health and wellness. In addition, Komachin Middle School has made a conscious decision to provide on-campus opportunities to practice sustainability. Our school garden features a greenhouse, raised beds for vegetables, a butterfly garden, native plants, and a seasonal pond. Our school recycling program is run entirely by students and the money made is deposited back into the school's budget. We have worked with the school district officials and Puget Sound Energy to do energy analysis work. We are also proud of our strong partnerships with Global Rivers Environmental Education Network (GREEN), Stream Team, Thurston County Solid Waste, Pacific Disposal, Nisqually National Wildlife Refuge, and Washington Conservation Corps. These connections have provided numerous opportunities for our students to engage in real-life problem solving activities in their communities. Our efforts in the area of sustainability have earned us past Terry Husseman Awards, Apple Grants, Learn and Serve Grants, and Model Links Grants.

This year we are offering a new science enrichment curriculum which we proudly submit for the Terry Husseman Sustainable School Award. This is a nine week course that meets for almost an hour every day. Six science teachers offer it four times a year to a class of about twenty-five seventh and eighth graders. The class is entitled Inquiry and basically revolves around the science and real-life implications of solid waste. The objectives of the course are three-fold. First, our science staff is passionate about instilling a sense of environmental stewardship in our students. Secondly, we strive to build upon our students' science skills by incorporating the three Washington State science standard strands of Inquiry, Systems, and Application. Lastly, we have integrated our Service-Learning philosophy into this program.

Benefits achieved

Student Participation: Over the course of the school year, approximately 600 students will have taken this course. This represents about three quarters of our student population. In the past, we have had small groups of students run the recycling program for the whole school which resulted in about 100 students collecting recycling. When we implemented this curriculum this fall, we shifted the recycling responsibilities to this class and greatly increased the number of students actually performing the recycling tasks. The obvious benefit is that most of our students have a much more vested interest and understanding of how we run our recycling program and why. Our hope is that these students will take their skills and attitudes around recycling home and encourage their families to recycle.

topics related to garbage through lectures, readings, videos, guest speakers and internet activities.

Goal Two: The student will understand how social and natural systems are fundamental in supporting our lives, economy, and emotional well-being. While taking this class, students have numerous opportunities to realize the amount of trash they create. They also realize that although some solutions make more sense than others, any method used to deal with this trash has problems. The natural next step is for students to realize that the best way to maintain our natural systems is to minimize the amount of trash we do create. We also make a connection between the issues of garbage and clean water.

Goal Three: The student will recognize how individual decisions and actions impact the environment. Students explore different techniques for handling garbage such as composting, worm bins, recycling and landfills. They are able to learn first hand the plusses and minuses of each of these solutions. Students analyze their own buying power and choices by playing a "Shop Smart" game. By actively running the school's recycling program, students gain an appreciation of each individual's impact on what is recycled and what is thrown out in their school community.

Goal Four: The student will develop and utilize the knowledge and skills necessary for cooperative action to maintain or enhance the environment. Our students work together in small groups to provide recycling services throughout the school. At the end of the quarter, these small groups learn an auditing technique to examine and critique their particular classroom's garbage and recycling. They synthesize their opinions into a brochure which is given to the classroom's teacher. They also are given a chance to visit the local landfill and discuss possible problems and solutions with managing our community's garbage. A water quality monitoring field trip provides students with the skills needed to gage the health of our watersheds and to analyze potential threats to the watershed.

How our curriculum links with the Essential Academic Learning Requirements for our state

Washington State has structured science education into three overriding themes: Systems, Inquiry, and Application. Our Inquiry class incorporates these three themes.

Systems Approach: When studying the science behind recycling and garbage, we approach it from a systems perspective. For example, our lesson on composting revolves around the inputs, outputs, and transfers of matter and energy within a composting system.

Inquiry: As the course title suggests, our class provides ample opportunity for students to practice their inquiry skills. Students participate in three scientific investigations. They are allowed to choose their manipulated variable. For each of these investigations, different steps in the scientific method are emphasized. Toward the end of the course, students choose one of the investigations and develop a formal powerpoint to present to the rest of the class. We also provide WASL-style practice tests on designing a scientific investigation and writing a conclusion. We have noted an increase in students' confidence in their inquiry skills in their regular science class as a direct result of taking this course.

Application: The State wants our students to be able to use scientific principles to design solutions to problems. This is also a focus in this class. After studying the science behind composting, we challenge our students to design the most efficient system for decomposing an apple. Another example of application is our field trip to the waste and recovery center. Before the field trip, we discuss the problems inherently present at a landfill. The focus of the field trip is to witness how the County uses technology to solve these problems. We also discuss alternative ways that these problems could be handled.

How our curriculum uses environmental education as an integrating context for learning

Integrated-Interdisciplinary Instruction: Although the main emphasis of this course is environmental science, there is an integration of other disciplines. Technology is used in three main ways: research, powerpoint presentations, and developing brochures. Reading is critical in obtaining background information on the science we study and writing is critical for students to communicate their findings.

Collaborative Instruction: This course is co-developed and co-taught between six science teachers at Komachin. We are constantly collaborating on what works and what needs improvement. We also share supplies among the staff.

Community-Based Investigations: During this course, students study garbage issues at the personal, school, and community level. They participate in two field trips. One field trip is for water quality monitoring on the local streams. The second is a trip to the local landfill. The school garden is integrated into the curriculum. Guest speakers from the community are brought in as expert resources.

Learner-Centered, Constructivist Approaches: By splitting our classes into a group that needs a slower pace and a more structured environment and a group that can handle a quicker pace and more freedom in their scientific investigation, we are honoring our individual learners. We find that both groups respond positively to this adjustment. By giving students an opportunity to design their own investigations at different levels, we are honoring a constructivist approach. We also feel that involving students in a real recycling program enables them to construct their own attitudes around garbage instead of being told what is the right thing to do.

Cooperative and Independent Learning: Most of our activities are designed to be done in either partners or small groups. At the end of each big investigation, students come back together as a class to share their data. Students are challenged to work independently in developing and presenting their powerpoint on one investigation. However, they are allowed to make revisions based on peer input.

Local Natural and Community Surroundings as the Context for Learning: This is greatly emphasized in our curriculum. Our students study issues of solid waste in their own school and in their own community. They perform waste audits of the classrooms of Komachin and they visit the local landfill. We perform water quality monitoring on streams in the students' own watersheds.

Teacher Participation: This course is taught by seven members of our science staff (two members job share and teach one class between them). We are proud of the fact that we have nearly 100 percent participation in our recycling program among our staff. This includes are teaching staff, our library staff, our office staff, our custodians, our cooks, and our administrators. Our students are assigned to specific rooms for their recycling. Toward the end of the quarter, the students do an audit of their room's garbage and report back to the staff member on how well recycling is going in that room. In addition to the audit information, the student also reminds the staff member of how recycling works in the building and why it's important to recycle.

Community: We feel our curriculum benefits the community by producing citizens who are informed about issues regarding solid waste and are aware of sustainable choices to make right now and in their future.

Barriers or challenges we will face, or have faced, in designing and implementing our curriculum

1. Science WASL: The reality that this year's eighth graders must pass the Science WASL to graduate from high school influences the way we teach science at Komachin. It is tempting to feel that we do not have time in our curriculum to focus on sustainability issues or service-learning. Fortunately, we know that this would do a great disservice to our students and their community. Instead, we have taken this opportunity to reflect on how we teach. We feel the State standards have only improved our teaching. We have been challenged to delve deeper into the science of garbage. We are also providing more opportunities for students to design their own scientific investigations and solutions to real problems in the area of sustainability. Also, by teaching within a real-life context, we find that our students are much more engaged in their learning.

2. The Middle School Student: Teaching middle school-aged children provides some unique challenges when exploring issues of environmental stewardship. Middle school students tend to be rather ego-centric. They can be apathetic toward social and environmental issues. It can be challenging to get them to think beyond themselves and their peers to their community at large. Another challenge is that, although they are at the verge of thinking in the abstract, they are much more comfortable with concrete, tangible tasks. We have taken these unique characteristics of middle school children in mind when designing this curriculum. Although we ultimately want them to be able to understand their role and influence in their community in the realm of resource consumption, we have designed very middle-school friendly activities that engage the student and provide the scientific background they will need to make good decisions. Most of the activities are very "hands-on" and we have incorporated field trips. Most importantly, our program actively engages the students and gives them a role in the school's recycling program.

3. Funding: A third challenge that our program faces is funding. As stated above, our curriculum relies on field trips and hands-on labs to engage our learners. It takes money to sustain this style of teaching. It also takes time to buy and organize supplies, to communicate between seven teachers sharing resources and to bring in guest speakers. We teach this course on top of our regular science class. Any award we receive will go

directly back into our program. We will use it to buy supplies, pay for field trips, and to provide a stipend for one teacher to act as a coordinator.

Please describe anything else you would like us to know about your school or program that does not fit into the other questions

Although mentioned above, we want to stress the role of service learning in our curriculum. While taking this class, students learn about the science and issues behind recycling and solid waste. They are also immersed first-hand into what it takes to facilitate a recycling program. The students in our Inquiry class run our recycling program. In the first week, students are trained and assigned to a teacher for whom they pick up recycling for the next two months. They become an expert in Komachin's recycling program. Not only does this make the curriculum more meaningful to our students, but it makes our students more invested in our recycling program. They get why we want them to be thoughtful about how they sort their recycling. They can appreciate the amount of work that goes into running a program. Toward the end of the class, they have an opportunity to do a mini-audit of their teacher's recycling. This gives them a chance to critique how well the program is operating and provide specific feedback to their teacher and that teacher's students. These students also tour the local waste and recovery center. This provides them with some perspective on the amount of garbage that is handled at the County level. Perhaps this experience will affect their attitude about garbage and recycling outside of the school environment. We feel our students learn best when given a chance to practice what they are studying. This is why service learning plays such a critical role in this course.

There is another unique aspect of our curriculum that we would like to share. We have chosen to divide our students into two groups. One group is composed of students who have demonstrated both a high maturity level and more refined skills in science. These students are a separate class and are allowed to work much more independently. Students in this class work in small groups to design and carry out their own scientific investigation from start to finish. The other group is comprised of students who either need more structure or whose science skills are not as well-developed. This class moves a little less quickly and has a higher emphasis on the skills involved in the scientific method. These students still have some say in how they want to perform their scientific investigations, but they are not ready to design and implement an open-ended investigation on their own. Splitting the classes in this manner has proven to work well for both types of students as well as the teachers.

How our curriculum meets the four goals identified in the Environmental Education Guidelines for Washington Schools

Goal One: The student will develop knowledge about the components of the environment and understand their interactions within natural systems. We believe that it is imperative for our students to understand the components of the environment and their interactions within natural systems before they can be genuine stewards of their environment. This is why we have integrated numerous scientific investigations into this curriculum. We have also provided ample opportunities for students to gather background information about the

How our curriculum provides instruction on the environmental benefits of practicing sustainability

The main focus of this curriculum is solid waste. The "hook" that we have chosen to get students to buy in to this topic is to involve them in Komachin's recycling program. We weave in scientific investigations on composting, worms, soil, plant, growth and water quality. There are two major student projects: a formal presentation on one of the investigations and a classroom waste audit report. To connect our students to their local community, we take them on a field trip to test water quality and we take them on a tour of the local waste handling facility. Our ultimate goal is for our students to have the scientific knowledge and hands-on experience to make sustainable decisions regarding their garbage both in their immediate lives at Komachin and as future decision makers.

Inquiry Curriculum

Scope and Sequence

Themes:

Recycling at Komachin
Composting and Worms
Soil and Plant Growth
Water Quality
Scientific Method and Presentations
Landfill Field Trip
Garbage Audit and Brochures

- Get Acquainted Activity
- Science Attitude Survey
- Class Overview and Expectations

- Recycling at Komachin Powerpoint
- Recycling Quiz and Reading
- Tour school's recycling facilities
- Get into recycling groups and assign classrooms

- Watch "Recycling Rainbow Returns" video
- Recycle for first time, students continue to recycle at least once a week for the remainder of the quarter

- Online Recycling web search

- Read "How Composting Works"
- Science skill focus: variables
- Introduce Apple Lab and Designing a Solution to a Problem template

- Finish setting up Apple Lab and set aside

- Dr. Rot presentation from Thurston County Solid Waste (worm composting bins)

- All About Earthworms online activity and watch video: Darwin's Plow

- Worm Lab

- Wigglin' Worms Lab Day One (This activity is adapted from *The Truth About Science: A Curriculum for Developing Young Scientists* by Kathryn Kelsey and Ashley Steel)
- Science skill focus: controls

- Wigglin Worms Lab Day Two
- Science skill focus: writing a conclusion

- Start Plant Growth Lab: plant radish seeds in three types of soil (one of which is from school garden), gather data over the next week
- Science skill focus: responding variable (measuring plant growth)

- Test 3 soils used in Lab with soil testing kits and procedures
- Science skill focus: writing a good hypothesis, students use background info over the next 3 days to revise their initial hypothesis about plant growth

- Soil Background: All About Nitrogen, Phosphorous, and Potassium Reading
- Characterizing Soil Activity using 3 soils types used in lab

- Introducing Soil Web Search online activity

- School Garden Scavenger Hunt

- School Garden work party, could revolve around replenishing soil with whatever nutrients are found lacking from soil tests

- Conclude Plant Growth Lab
- Focus on managing data from the large group and the concept of multiple trials

- Guest Speaker: Susie Vanderburg, Thurston County Stream Team, on local watershed issues

- Introduce water quality tests, readings from classroom booklets, sign up for tests

- Start water quality investigation: use 3 different types of water samples to run an investigation

- Finish up water quality investigation, discuss field trip etiquette

- GREEN Water Quality Monitoring Field Trip

- Debrief and reflect on field trip, share and analyze water quality data

- Scientific Method Practice Test

- Scientific Method Online activity

- Conclude Apple Lab, each group presents the composting system they designed and how efficient it was at decomposing the apple

- Introduce presentation project: each student chooses an investigation to develop into a formal lab write-up using powerpoint, this serves as an assessment of their understanding of designing an investigation or designing a solution to a problem, pass out rubric
- Show Scientific Method Slide Show
- Work independently on presentations
- Work independently on presentations
- Work independently on presentations
- Work independently on presentations
- Work independently on presentations
- Present powerpoints to class, students use rubric to provide feedback to peers
- Present powerpoints to class, students use rubric to provide feedback to peers
- Students revise presentations based on peer feedback and print out a "slide" copy to turn in
- Prep for Landfill Fieldtrip: Powerpoint and worksheet, focus on solutions to problems with landfills and vocabulary
- Fieldtrip to Local landfill
- Debrief fieldtrip and introduce Classroom Garbage Audit activity
- Model auditing technique for the class
- Perform Classroom Garbage Audits
- Develop Garbage Audit brochures
- Develop Garbage Audit brochures
- Develop Garbage Audit brochures and give to classroom teachers
- Shop Right Game
- Last Day, organize work from the quarter, reflection, and Celebrate with Dirt Cups!

Notes:
This is a sample scope and sequence for a 45 day, or nine-week course. In reality, the flow would change in response to guest speakers, field trip opportunities, the school calendar, and weather.

The Wigglin' Worm Lab, Plant Growth Lab, and Water Quality Lab all use the blank lab template provided.

Science Inquiry

Getting to know you, getting to know a little about you....

Your name:_____

Directions: When told to do so stand up and mingle with your classmates. Find one person that knows the following information and have them write their full name on the line. Once every line has been signed, sit down and wait for everyone to finish. We will then share our answers with the whole group.

1. Someone who knows where the KMS garden is:_____
2. Someone who has been in the KMS greenhouse:_____
3. Someone who has a garden at home:_____
4. Someone who loves broccoli:_____
5. Someone who can name at least 4 stages of the water cycle:_____
6. Someone who recycles at home:_____
7. Someone who recycles at KMS:_____
8. Someone who knows which bin at KMS you would put newspaper in:_____
9. Someone who can give 3 reasons everyone should recycle:_____
10. Someone who knows where our garbage ends up:_____
11. Someone who knows the name of KMS's watershed:_____
12. Someone who can name the watershed they live in:_____
13. Someone who has participated in water quality monitoring:_____
14. Someone who can name 3 reasons you should plant trees:_____
15. Someone who conserves water in some way:_____
16. Someone who has visited another country:_____
17. Someone who has swam in the Atlantic Ocean:_____
18. Someone who has gone sailing in Puget Sound:_____
19. Someone who has floated in the Great Salt Lake:_____
20. Someone who has gone snorkeling:_____
21. Someone who loves to eat crab:_____
22. Someone who has been on a camping trip for longer than 1 week:_____
23. Someone who can name 3 endangered species:_____
24. Someone who knows what an ichthyologist is:_____
25. Someone who knows the difference between a slug and an earthworm:_____

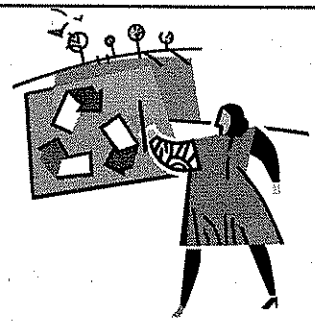
Science Attitude Survey

Consider the following types of things we do in our science class. For each type of activity, rank both how well you think you do on it and how much you like doing it.

- A "1" means you don't do well/you really don't like.
- A "5" means you do really well/you really like to do it.

Type of Activity	How Well I Do	How Much I Like It
Reading from the textbook		
Taking notes		
Class discussions		
Teacher demonstrations		
Writing conclusions		
Doing labs/experiments		
Collecting data		
Working with lab partner		
Answering questions outloud		
Answering questions on paper		
Writing lab conclusions		
Making graphs		
Taking tests		
Writing lab reports		
Making models		
Making hypothesis		
Writing procedures		
Watching videos		

RECYCLING AT KOMACHIN



WHAT WE RECYCLE

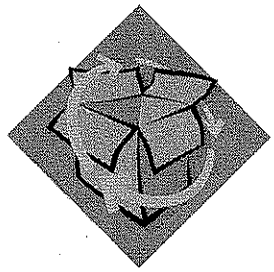
MIXED PAPER

All paper goes in the same bin:

- **White paper**
- **Color paper**
- **Newspaper**
- **Cardstock**
- **Some tape and/or glue ok**

Does <u>not</u> include tissues, paper towels or any paper contaminated with food! YUCK!

CARDBOARD



- **Corrugated cardboard only! This means you can see the wiggly layer of cardboard in between the straight layers.**
- **Non-corrugated cardboard goes in mixed paper.**
- **Flatten and place boxes behind recycling bins for pick-up.**

PLASTIC BOTTLES

- **Top of bottle must be smaller than base to be recyclable**
- **Should be empty, but not totally dry**
- **Lid and labels are ok**

ALUMINUM CANS

- **If there is no bin for cans in the classroom, place in plastic bottle container**

WHAT WE CAN'T RECYCLE

- **Kleenex**
- **Paper towels**
- **Shredded paper (makes a mess outside)**
- **Food-contaminated items**

HOW WE RECYCLE

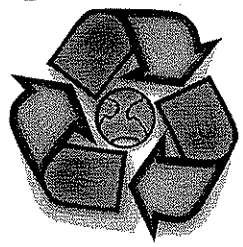
Our program is run by you, the students!

- **For the first enrichment cycle, an advisory from each house will collect recycling.**
- **After that, students in the science enrichment classes will collect recycling.**
- **Service hours are earned by recyclers.**

WHY WE RECYCLE

- Recycling saves trees.
- Recycling protects wildlife habitat and biodiversity.
- Recycling lowers the use of toxic chemicals.
- Recycling helps curb global warming.
- Recycling stems the flow of water pollution.
- Recycling reduces the need for landfills.
- Recycling reduces the need for incinerators.
- Recycling creates jobs and promotes economic development.
- Buying recycled products contributes to the demand for *more* recycled products.

Thank You for Doing Your Part!



Where do I put my "Garbage"?
Key with Notes

Item	Mixed Paper	Card-board	Plastic Bottle	Aluminum Cans	Garbage
Kleenex					X
Although made of paper, Kleenexes are contaminated and must be considered garbage, even if not used.					
Notebook Paper	X				
Even if written all over!					
Empty tissue box	X				
These are made of cardstock, not cardboard. Cardboard has the corrugated (bumpy) layer in the cross section. Remove any plastic before recycling.					
Pop cans from classroom party				X	
Most classrooms do not have a container for these. They can be placed in a bag for pickup or taken to staff room container for aluminum.					
Pizza box with cheese stuck to it					X
We cannot recycle anything contaminated with food.					
Paper towel					X
Paper towels are also considered contaminated and do not go in recycling.					
Plastic yogurt container					X
Our plastic recycling is for bottles only. The definition of a bottle is that the top is smaller than the bottom!					
Juice bottle from commons			X		
These do not need to be totally empty. However, do not recycle with a significant amount of juice still inside the bottle. Lids on the bottle are OK. In fact it's preferable so that juice doesn't get all over! Don't worry about the label either, it can stay on.					
Stapled packet of worksheets	X				
Staples are okay in recycling.					
Plastic pen					X
Only plastic bottles in recycling!					

Small pieces of shredded paper					X
These get blown all over the place when students dump the recycling into the dumpsters. Although technically recyclable, they are better off in the garbage.					
Graded school project (poster board with paper glued to it)	X				
If you're sure you don't need it, this can be recycled. Don't worry about small amounts of tape or glue. However, glitter or other non-recyclable items attached either need to be removed, or the whole thing needs to go into garbage.					
Spiral notebook that's used up	X				
Pages must be torn out and metal binder thrown in garbage.					
Candy wrappers					X
Usually waxy or plastic-coated and not recyclable.					
Cardboard box		X			
Break down flat and place behind recycle bins. Look for corrugated (bumpy) layer to determine that it is cardboard and not mixed paper.					
Empty donut box					X
Probably food-contaminated and therefore garbage.					
Food items					X
Should be composted. Perhaps we need a composting program at KMS.					
Used overhead transparency					X
Again, not a bottle, so not recyclable.					

Where do I put my "Garbage"?

Use the information you just learned about recycling at Komachin to check the most appropriate box for disposing of the following items.

Item	Mixed Paper	Card-board	Plastic Bottle	Aluminum Cans	Garbage
Kleenex					
Notebook Paper					
Empty tissue box					
Pop cans from classroom party					
Pizza box with cheese stuck to it					
Paper towel					
Plastic yogurt container					
Juice bottle from commons					
Stapled packet of worksheets					
Plastic pen					
Small pieces of shredded paper					
Graded school project (poster board with paper glued to it)					
Spiral notebook that's used up					
Candy wrappers					
Cardboard box					
Empty donut box					
Food items					
Used overhead transparency					

Solid Waste

Every year, the United States generates approximately 200 million tons of "trash"--about 4.3 pounds per person per day. Less than one-quarter of it is recycled; the rest is incinerated or buried in landfills. With a little forethought, we could reuse or recycle more than 70 percent of the landfilled waste, which includes valuable materials such as glass, metal, and paper. This would reduce the demand on virgin sources of these materials and eliminate potentially severe environmental, economic, and public health problems.

Could We Bury It?

The U.S. Environmental Protection Agency estimates that half of all landfills operating today will be closed by the year 2000 for one or both of these two reasons:

- They will be full.
- They will be contaminating groundwater. The water that flows beneath these deep holes is our drinking water. About 86 percent of U.S. landfills are leaking toxic materials into lakes, streams, and aquifers. Once groundwater is contaminated, it is extremely expensive and difficult, sometimes even impossible, to clean it up.

Could We Burn It?

Yes and no. Incineration does generate energy, but at a cost--it may release toxins into the air and create ash that requires disposal in hazardous-waste landfills, and that takes us back to our starting point: Cities are running out of places to put their trash.

Could We Pay Someone to Take It?

Not likely. As our population grows, former outlying areas are becoming bedroom communities, and their residents mount stiff opposition to plans for expanding existing landfills or creating new ones, even in return for some perks. And as local and state government officials cope with the costs and problems of their own waste disposal, they are less willing to import other communities' waste and the pollution it generates. So where does this leave us?

Recycling Trivia Name:_____

1. Go to http://www.resourcefulschools.org/html/facts.html
2. Read the "Fun Facts about Recycling" to answer the following questions.
3. Click on "Recycling Trivia Challenge" up at the top of the page. Click on "Quiz Me". Use your notes to answer the questions.
4. Click on "Score Me". How many did you get right? _____

How many trees does it take to make a ton of paper?

What is said to be the highest point in Ohio?

What kind of trash makes up the largest part of our waste stream?

How much paper does the average American use in one year?

How many pounds of pollutants can one tree filter in a year?

Every day businesses generate enough paper to circle the world how many times?

What Does "Cycler the Robot" Do and in what country does he live?

Why do new landfills cost more than old ones?

How many Styrofoam cups do Americans throw out in a year?

How many trees are cut down each year to supply raw materials for American paper and pulp mills?

What is a "nappy"?

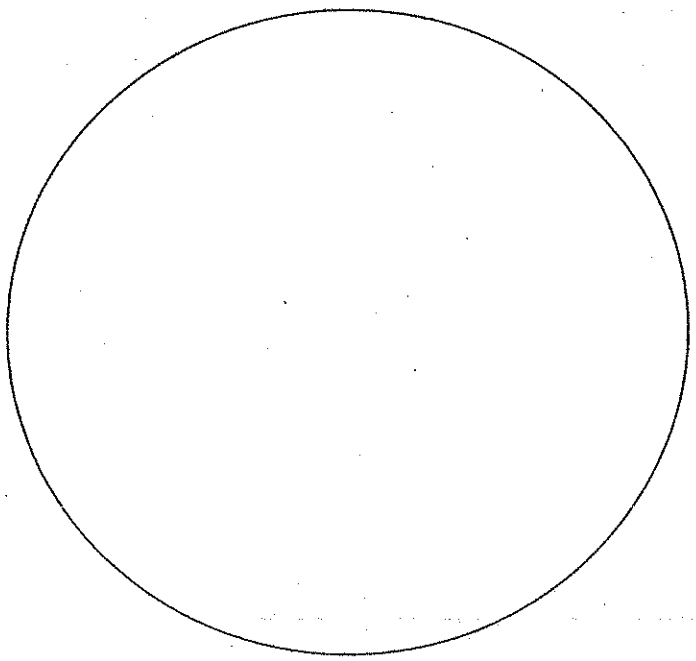
How much water can be saved for one ton of paper recycled?

What percent of the world's water supply is usable?

How many trees are wasted every Sunday based on newspapers typically thrown out?

What's in America's Garbage?

1. Go to: http://www.epa.gov/epaoswer/non-hw/reduce/catbook/what.htm
2. Label the Pie Graph with the appropriate type of garbage and the percentage.
3. Predict how this Pie Graph would look like if we did an audit of Komachin's garbage, considering our recycling program. Use the blank circle and fill in with your predicted percentages.



How Composting Works
by Craig C. Freudenrich, Ph.D.

Americans generate about 210 million tons (231 million short tons) of trash, or **solid waste**, each year. Most of this trash (57 percent) gets placed in municipal landfills. About 56 million tons (27 percent) is recovered through either recycling, in the case of glass, paper products, plastic or metals, or through composting, in the case of yard waste. **Composting** is a method for treating solid waste in which organic material is broken down by microorganisms in the presence of oxygen to a point where it can be safely stored, handled and applied to the environment. Composting is an essential part of reducing household wastes. It can be done inexpensively by every household and produces a product -- **finished compost** or **humus** -- that can benefit the environment as a natural fertilizer for gardening and farming.

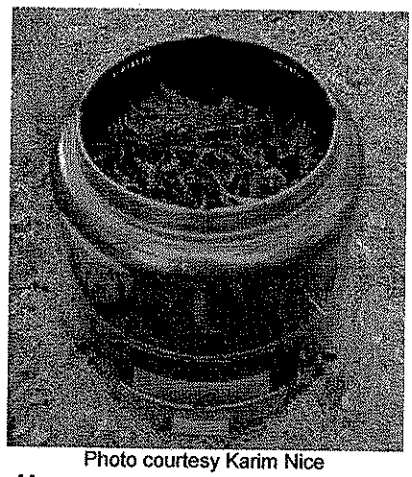


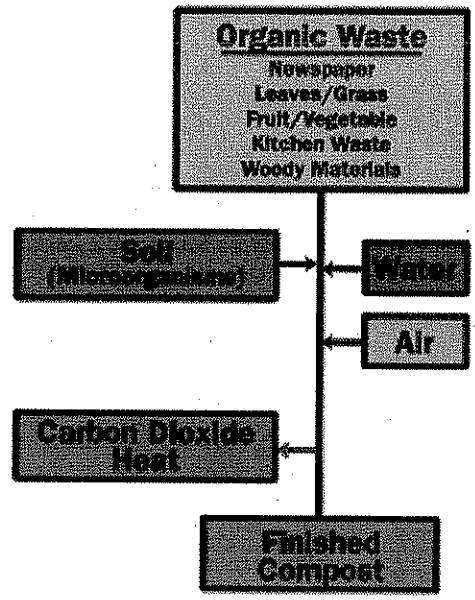
Photo courtesy Karim Nice
Home composting is an ideal way to reduce solid waste.

Composting Biology

Composting creates the ideal conditions for the natural decay or rotting processes that occur in nature. Composting requires the following:

- **Organic waste** - newspaper, leaves, grass, kitchen waste (fruits, vegetables), woody materials
- **Soil** - source of microorganisms
- **Water**
- **Air** - source of oxygen

During composting, microorganisms from the soil eat the organic (carbon containing) waste and break it down into its simplest parts. This produces a fiber-rich, carbon-containing **humus** with inorganic nutrients like nitrogen, phosphorus and potassium. The microorganisms break the material down through **aerobic respiration**, and require oxygen that they get from the air you introduce when you turn the material in the compost bin. The microorganisms also require water to live and multiply. Through the respiration process, the microorganisms give off carbon dioxide and heat -- temperatures within compost piles can rise as high as 100 to 150 degrees Fahrenheit (28 to 66 C). If the compost pile or bin is actively managed by turning and watering it regularly, the process of decomposing into finished compost can happen in as little as two to three weeks (otherwise, it may take months).



The compost process

The compost conditions must be balanced for efficient decomposition. There must be:

- **Plenty of air** - mixture should be turned daily or every other day
- **Adequate water** - mixture should be moist, but not soaking wet
- **Proper mix of carbon to nitrogen** - ratio should be about 30:1 (see Elements of Composting: C:N ratio and Virtual Pile for details)
- **Small particle size** - big pieces should be broken up, as smaller particles break down more rapidly
- **Adequate amount of soil** - should provide enough microorganisms for the process

The compost pile actually has a complex organization of living organisms -- a **foodweb**. Bacteria and fungi primarily break down the organic matter in the trash. Single-celled organisms (**protozoa**), small worms (**nematodes**), and mites feed on the bacteria and fungi. Predatory nematodes, predatory mites and other invertebrates (sowbugs, millipedes, beetles) feed on the protozoa, mites and nematodes. All of these organisms work to balance the population of organisms within the compost, which increases the efficiency of the entire process.

Why Compost?

The major goal of composting is to **reduce the amount of solid waste** you generate. If you reduce solid waste, you will save space in municipal landfills, which will ultimately save you tax money. Finished compost has the advantage of being a useful natural fertilizer that is more environmentally friendly than synthetic fertilizers.

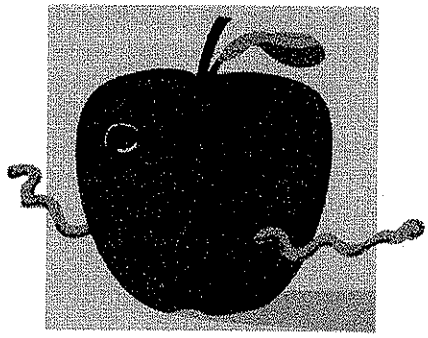
Name:_____

Design a Solution to a Problem: Apples to Soil

You and your partner's challenge is to use the following materials to compost one half of your apple into soil as quickly as possible. This will be your "Experimental Apple". You will also set up a "Control Apple" under identical conditions as everyone else's Control Apple. After setting up your experiment, your apples will be allowed to sit for a few weeks. When we complete the experiment, you can compare your experimental apple with your control apple. Use what you have learned about the decomposition process to turn your apple into soil!

Materials:

- 2 apple halves
- two plastic baggies
- dirt
- leaves
- worms
- water
- air



Using only the materials listed; describe how you would scientifically design a way to decompose your apple.

Be sure to describe the following phases of a scientific design process:

- Gather Information: Describe the scientific information you have or need to solve the problem.
- Explore Ideas: Describe several ideas you have to solve the problem, including any useful scientific concepts.
- Plan: Write a simple plan, including reasons for choosing this solution
- Diagram of Plan: Make a labeled diagram of your solution.
- Steps to Do the Plan: Write the steps you need to take to do your plan.
- Test Solution: Describe the measurements needed to evaluate the effectiveness of your solution.

Problem: Compost one half of your apple into soil as quickly as possible.

Gather Information:

Explore Ideas:

Plan:

Steps to Do the Plan:

Labeled Diagram of the Plan:

Test Solution:

All about Earthworms
Name:_____

Log on to http://yucky.kids.discovery.com
Click on Worm World
Click on All about Earthworms
Read and answer the following questions:

1. How many species of worms are there?

2. How many kinds of earthworms?

3. Draw and label the inside of a worm below:

4. Describe the functions of the following body parts:
   a. Pharynx:
   b. Esophagus:
   c. Crop:
   d. Gizzard:
   e. Intestine:
   f. Bloodstream:
   g. Anus:

Click on Worms as Recyclers and answer the following questions:

5. Describe how and what worms recycle:

6. What would happen without the help of worms?

7. What do worms give to the soil after they decompose refuge?

On the back of this paper explore the website. Be sure to read the interview with Eddie the Earthworm and the baby earthworm being born. On the back of this worksheet write down 10 more interesting things you learned about earthworms.

Movie: Darwin's Plow, 13 minutes Name:_____

1. What is the lump of dirt found near an earthworm's tunnel?

2. What is the role of the gizzard in the earthworm?

3. What does an earthworm eat?

4. Why is the earthworm so important for plants?

5. What two benefits do the earthworms' tunnels provide for plants?

6. According to Darwin, why are many ancient cities buried underground after so thousands of years/

7. How does the earthworm move?

8. How does an earthworm know how to avoid light if they do not have eyes?

9. Name at least three facts about earthworm sexual reproduction.

10. How many worms do scientists estimate live within an acre of land?

Earthworm Observation Lab

Problem: What are some behaviors of earthworms?

Materials:

1. Black paper
2. Earthworms
3. Wet and dry paper towels
4. Pie pan

Procedures:

1. Sketch the earthworm and label the mouth, anus and clitellum.
2. Using a hand lens sketch one section of the earthworm.
3. Using the hand lens count and record the number of segments in a 1cm section.
4. Examine the ventral and dorsal sides of the earthworm. You should see some tiny bristles. This are called setae, describe them.
5. Measure the length of your earthworm in centimeters. Record.
6. Measure the mass of your earthworm by placing it in a petri dish and putting it on the triple beam balance. Record.
7. Lay a dry paper towel on one half of the pie pan and a wet paper towel on the other half of the pie pan. Leave a space between the paper towels.
8. Put the earthworm on the wet paper towel and record observations for two minutes.
9. Place the earthworm on the dry paper towel and record observations for two minutes.
10. Remove dry paper towel from pie pan and replace it with another sheet of wet paper towel.
11. Lay a sheet of black paper over the top of half of the pie pan, and then put the worm in the middle. Record observations for two minutes, then remove paper.
12. Gently touch the earthworm with a dry cotton swab. Record its reaction.
13. Dip cotton swab in vinegar and hold it in front of the earthworms for two minutes. Record observations.
14. Return earthworms to proper container, throw away all paper towels and cotton swabs, and clean pie pans.

Earthworms

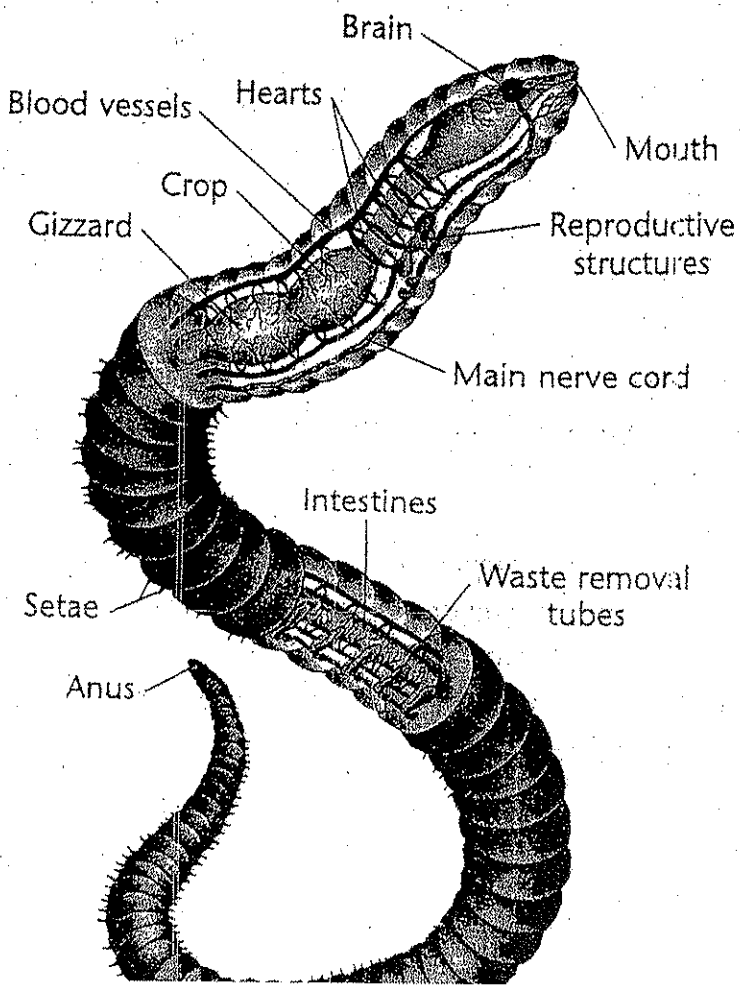
Phylum - Annelid : bilaterally symmetrical worms with round segmented bodies; terrestrial and aquatic species; well developed body systems; includes earthworms, leeches, and marine polychaetes.

Earthworms

The earthworm is a segmented worm, the most developed of three broad groups of worms. Its body may have more than one hundred segments. The earthworm's peculiar way of eating is what makes it so valuable to farmers and gardeners: It literally eats its way through the soil. The decaying plant and animal matter in the soil is digested as it passes through the earthworm's body. The eliminated soil is improved in fertility, but the side effects are even more important. The soil is loosened and aerated. Also, mineral-rich soil below the depleted surface is brought up and mixed with mineral-depleted surface soil. The earthworm moves through and on the soil by alternately stretching and contracting its body.

Earthworms are skin breathers. That is, they take in oxygen and release carbon dioxide directly through the skin. For this to happen their skin must be moist. Handling dries out their skin, so it's important to have wet hands or to use wet paper and a spoon if they need much handling.

PARTS OF AN EARTHWORM



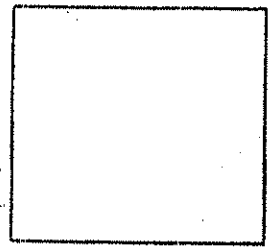
Earthworm Lab

Name:

Observations:

Sketch of Earthworm: Label mouth, anus, and clitellum

Sketch using hand lens:



Earthworm	Data or description
Number of segments (rings)	
Description of setae	
Color, texture, etc.	
Length in cm	
Mass in g	

Stimulus	Earthworms Reaction
Wet paper towel	
Dry paper towel	
Black paper	
Dry Cotton Swab	
Vinegar Swab	

Analysis:

1. Based on your observations do you think the earthworm has a sense of smell? Why or why not?

2. Based on your observations do you think the earthworm has a sense of touch? Why or why not?

3. Based on your observations do you think the earthworm can sense light? Why or why not?

Conclusion: One paragraph

- What were you trying to find out?
- What were two things you learned about earthworms that you didn't already know?
- What were two things that really surprised you?
- Concluding sentence...In conclusion I would say...

Name:_____

Name of Lab:

Question/Problem: What are you trying to learn?

Background Information: What do you already know?

-
-
-

Hypothesis/Prediction: What do you think will happen?

If

Then

Because

Materials: What will you need for this investigation? (Include a measuring devise!)

Variables:

- Manipulated Variable (what you are intentionally changing)
- Responding Variable (what you are observing and measuring)
- 3 Controlled Variables (things you are keeping the same, or controlled, throughout the experiment to ensure a fair experiment)

Procedures:

- How will you test your hypothesis?
- Be logical, can someone else repeat them?
- Say how much of everything is needed and how long to carry out steps.
- Explain what needs to be measured and how to measure it.
- Include repeated trials! (Even though we may not do them!)

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

Data Table:

Conclusion:

- Explain the question
- Explain the hypothesis
- Explain your observations, your data, use numbers!
- Does the data support your hypothesis? Where you right?
- What did the investigation show you?

Scoring Rubric

Investigation Attributes	Description of Attribute	Value Point
Prediction	The prediction must be related to the investigative question and include both the manipulated variable (chewing time) and responding variable (mass of the gum after chewing)	1
Prediction Reason	Though giving a reason for the prediction is not expected at this level, a value point may be awarded for a reason for the prediction such as "The longer the gum is chewed, the less the gum's mass because chewing takes out the sugar." (Note: At this level, a prediction, which is supported by any reason, justifies the 'prediction reason' value point.)	1
Materials	A list of the minimum materials (gum, balance, and stop watch) needed to perform the procedure must be listed in this section.	1
Procedure	The written or diagrammed procedure is evaluated as follows.	up to 6
One Controlled (kept the same) Variable	At least one **controlled variable** (kept the same) is identified or implied in the procedure or materials such as one type of gum, the chewing rate, or the way the gum is massed	1
Manipulated (changed) Variable	The time of chewing is identified or implied in the procedure or data table (if given) as the only **manipulated (changed) variable.**	1
Responding (dependent) Variable	The mass of gum after chewing is identified or implied in the procedure or data table (if given) as the **responding (dependent) variable.**	1
Repeated Trials	More than one trial is planned to measure the responding (dependent) variable for at least one condition.	1
Record Measurements	The procedure explicitly states "record" or gives a data table. If artificial data is given, no value point may be awarded.	1
Logical Steps	The steps of the investigation are **logical** with enough detail to repeat the procedure effectively.	1
	Total Value Points Possible	9

Notes:
1. No points may be awarded for an investigation that repeats of the scenario investigation.
2. One meaning of the word "it" may be inferred from a previous sentence.

Using the Soil Test Kit

Question: Of the three soil samples I select, which sample would have the most Nitrogen, Potassium and Potash.

Background Information on Nitrogen, Phosphorous, and Potash.

Manipulated Variable: _____

Responding Variable: _____

Controlled Variables: _____

Materials:

Step One: Preparing your Soil Samples

1. Take sample of soil at least 4" deep in the bed.
2. Avoid touching the soil with your bare hands.
3. Place your soil sample into a clean container.
4. Break the sample up with the trowel or spoon and allow it to dry out naturally.
5. Remove any small stones, organic material such as grass, weeds or roots and hard particles of lime.
6. Crumble the sample finely and mix it thoroughly.

Nitrogen, Potassium, and K Procedures;

1. Fill a 1000ml beaker with 250 ml of soil and 1000 ml of water. (Larger or smaller quantities may be tested as long as the 1 part soil to 5 parts water are maintained) Best results with distilled water.

2. Thoroughly shake or stir the soil and water together for at least one minute; then allow the mixture to stand undisturbed until it settles (30 minutes to 24 hours, dependent on soil). A fine clay soil will take much longer to settle out than a coarse sandy soil. The clarity of the solution will also vary, the clearer the better, however cloudiness will not affect the accuracy of the test.
3. Select the appropriate comparator for the test you wish to make. Remove the cap and take out the capsules which should be the same color as the cap.
4. Fill the test and reference chambers to the fill mark on the chart with solution from your soil sample. Avoid disturbing the sediment. Transfer only liquid.
5. Remove one of the appropriate colored capsules from its poly bag. Holding the capsule horizontally over the test chamber, carefully separate the two halves and pour the powder into the test chamber.
6. Fit the cap on the comparator, making sure it is seated properly and caps tightly. Shake thoroughly.
7. Allow color to develop in the test chamber for 10 minutes.
8. Compare the color of the solution in the test chamber to the color chart. For best results, allow daylight (not direct sunlight) to illuminate the solution. Judge colors, if necessary, and note your results for future reference. Follow these steps for each of the N, P, and K tests.

Soil Fertility

Have you ever planted a seed or seeds in soil and watched in amazement as tiny chutes begin to emerge from the soil and then eventually grow into a healthy, stable plant? Did you know that besides needing water (which is very important!) the type of soil that plants grow in and what actually goes on in soil determines how well plants grow? Five factors determine what types of soil form on Earth and critters that live in the soil are part of the amazing soil forming process:

Parent Material- the primary material from which the soil is formed. Soil parent material could be bedrock, organic material, an old soil surface, or a deposit from water, wind, glaciers, volcanoes, or material moving down a slope. Bedrock is broken down as water, wind, or other weathering processes wear away mineral particles from rocks.

Organisms- Soil is also formed as organic matter (such as leaves and dead plants) decomposes and as critters living in the soil change the chemistry of soil. Each of these parts work together to make soil that plants can grow well in. Fertile soils are those that have enough Nitrogen (N), Phosphorus (P), and Potassium (K), along with other nutrients that plants take up.

Topography- The location of a soil on a landscape can affect how the climatic processes impact it. Soils at the bottom of a hill will get more water than soils on the slopes, and soils on the slopes that directly face the sun will be drier than soils on slopes that do not. Also, mineral accumulations, plant nutrients, type of vegetation, vegetation growth, erosion, and water drainage are dependent on topographic relief.

Climate- heat, rain, ice, snow, wind, sunshine and other environmental forces break down the parent material and affect how fast or slow soil formation processes go.

Time- All of the above factors assert themselves over time, often hundreds or thousands of years.

Soil and plants play a very important part in the survival of humans and animals. Soil protects plant roots from exposure to the Sun's heat at Earth's surface, soil filters pollution that comes from rain and water runoff from farms. Soil is used to build with and on, and soil is what plants need to grow and be supported while growing. Plants are not only used for food but are also used to make fabrics and dyes, medicines and beauty products, fragrances, rubber and building materials, just to name a few.

The most important function of plants involves photosynthesis. Photosynthesis is a process in which all plants and algae as well as certain types of photosynthetic bacteria produce their own food, and in doing so take in carbon dioxide (CO_2) and then release oxygen (O_2) into Earth's atmosphere, which many living species on Earth need to survive.

You will learn here about three important minerals:

- **Nitrogen**
- **Phosphorus**
- **Potassium**

Plants must have these nutrients in order to grow healthy and strong.

WHY PLANTS LIKE NITROGEN (N):

Nitrogen (N) helps plants use carbohydrates to gain energy, like certain foods we eat help us to gain energy. Nitrogen controls how plants take their form and how they function inside, and nitrogen helps plants make protein that help them grow strong and healthy. Humans and animals benefit from eating vegetables and plants that are rich in nitrogen because proteins are passed on to humans and animals when they eat vegetables and plants.

THE NITROGEN CYCLE AND HOW NITROGEN MOVES THROUGH THE SOIL:

The nitrogen cycle involves certain processes that change nitrogen into different forms. Organic nitrogen in materials, like dead leaves and plants, are changed into inorganic nitrogen by microorganisms (critters) in the soil. Plants take up these available forms of inorganic nitrogen (NO_3^- and NH_4^+) so they can grow. Unfortunately, these forms of nitrogen are not always used by plants because they either get onto clay particles in soil, they leach into the groundwater because they cannot be absorbed by the soil, or they change into nitrogen gases that escape into Earth's atmosphere. Luckily there are specific kinds of microorganisms living in the soil that can convert gaseous forms of nitrogen into inorganic nitrogen that plants can use.

When plants die the dead plant matter falls to the ground and certain microbes, yet again, do their job of decomposing dead plant matter (which contains organic N) and changing it into inorganic N that living plants can use! This cycle is continuous. Processes in the nitrogen cycle are: Adsorption/Fixation, Denitrification, Erosion, Immobilization, Leaching, Mineralization, Nitrification, and Volatilization.

HOW PLANTS TAKE UP NITROGEN

Plants take up nitrogen in forms of nitrate (NO_3^-) and ammonium (NH_4^+). Most plants thrive on equal amounts of these ions but nitrates are more quickly available to plants because they move through the soil solution, whereas ammonium ions become fixed or held on to clay particles, called colloids, because of their positive charge.

WHAT HAPPENS WHEN PLANTS DON'T GET ENOUGH NITROGEN:

Plants deficient in nitrogen have thin, spindly stems and their growth is stunted. Their older leaves turn yellowish-green from nitrogen starvation (chlorosis), while newer leaves are supplied with the available, but limited nitrogen.

WHAT HAPPENS WHEN PLANTS GET TOO MUCH NITROGEN:

Plants that get too much nitrogen have alot of foliage (leaf) growth but are not strong. Plants that are not strong can get diseases more easily, can be bothered more by bugs, and can eventually fall over and die. An excess amount of nitrogen in plants can affect the amount of sugar and vitamins in fruits and vegetables, making them taste different. More importantly excess nitrogen can build up in plant tissues causing toxicity (poisoning) in livestock and in small children who eat nitrogen rich, leafy vegetables.

WHY PLANTS LIKE PHOSPHORUS (P):

Phosphorus (P) plays an important part in how plants and animals form and in how they function and grow. Phosphorus is known to help plants during photosynthesis, P helps plants respire (breathe), P provides energy transfer and storage, and P also helps plants efficiently use water. Seedlings and roots grow more quickly and vegetable and fruit production is increased when plants get enough phosphorus. Soil phosphorus comes mainly from the weathering of rocks that contain the inorganic mineral Apatite

Because minerals containing P are mostly insoluble and because P is fixed, or held, on to soil particles that erode away during rain storms, plants cannot get enough P. Over the past 100 years, farmers and gardeners have heavily added phosphorus fertilizers to their fields to help plants get more of this nutrient.The main reason phosphorus pollution occurs in the environment is because too much P fertilizer is added to soil, then during rain storms it travels on soil particles, across the land, and into surface waters.

Unfortunately, excess P in the environment has caused and continues to cause pollution in streams, rivers, lakes, and groundwater which is used for drinking water. Aquatic life and wildlife living in and around these waterways also are affected.

HOW PHOSPHORUS MOVES THROUGH THE SOIL AND HOW PLANTS TAKE UP PHOSPHORUS:

Inorganic and organic forms of P are found in soils, with most organic P being located at the soil surface. The same processes for nitrogen also occur for P: organic

forms of phosphorus are changed into inorganic forms of P by microbial activity in the soil (mineralization) or when inorganic forms of P are changed into organic forms of P that plants cannot use (immobilization).

Soil pH affects phosphorus availability to plants. In alkaline soils, in arid climates, calcium phosphate ($CaPO_4$) is dominant. If soil pH gets too high a chemical reaction takes place that fixes the phosphorus and makes it insoluble and unusable by plants. In acid soils aluminum phosphate ($AlPO_4$), iron phosphate ($FePO_4$) and sometimes manganese phosphate (MnPO4) are dominant. If soil pH gets too low a chemical reaction takes place that fixes phosphorus to Al, Fe, or Mn and phosphorus becomes insoluble and unusable by plants.

Other factors that prevent plants from taking up phosphorus include lack of oxygen, low soil moisture, low organic matter, extreme temperatures within soil, soil type, and plant type. Plants living in highly weathered soils use organic forms of phosphorus; plants living in soils that contain organic matter and are less weathered use inorganic forms of phosphorus.

When soil contains enough organic matter (dead leaves and plants) at Earth's surface P cannot become fixed as easily to clay surfaces. Adding organic matter to soil gives plants more time to take up P before P become fixed.

Of all phosphorus in existence on Earth, only 0.01% becomes available for plant use!

WHAT HAPPENS WHEN PLANTS DON'T GET ENOUGH PHOSPHORUS:

Plants that don't get enough P have spindly, thin-stems that are weak. Their growth is stunted or shortened, and their older leaves turn a dark bluish-green. The ability of phosphorus deficient plants to produce seeds, flowers, and fruits is deminished. Farmers and gardeners add P fertilizer to soil to so their plants wont become unhealthy.

WHAT HAPPENS WHEN PLANTS GET TOO MUCH PHOSPHORUS:

Phosphorus is hard for plants to obtain, let alone get too much of because:

1.) inorganic P is scarce in the environment

2.) P can quickly become fixed on to soil

3.) P gets eroded in rain water runoff to streams, rivers, and lakes.

WHY PLANTS LIKE POTASSIUM (K):

Potassium (K) is very important in the plant photosynthesis process and in helping plants metabolize their food to get energy, like humans and animals do when they eat. Potassium controls water and chemicals inside plants that help plants function well. Potassium also controls the absorption of water into plant pores, like the pores on your skin.

HOW POTASSIUM MOVES THROUGH SOIL AND HOW PLANTS TAKE UP POTASSIUM:

K is found in high levels in most soils, except in those soils containing sand, but the availability of K to plants is low because a large percentage of K is held in mostly unavailable forms to plants. K can be held inside a clay particle as part of the clay's structure, or it can be held outside on the edges or surface of a clay structure because it has a positive charge.

Of all soil K, 90-98% is held in primary mineral structures that are very resistant to most weathering processes, and therefore not easily available to plants. This form of K is known as inorganic structural K. Roots of some plants do have the ability to take up K from solution around these primary minerals, making these minerals dissolve more easily.

Secondary minerals, such as vermiculite and smectite clays, adsorb or fix K on to their edges and in between their crystal layers, making K only slowly available to plants. This form of K is called nonexchangeable K.

More readily available K for plants is found on the surface of clay particles (colloids) where they can exchange places with other similar sized and positive charged ions in the soil solution. These forms of K are called exchangeable K and solution K. K in soil solution is the easiest form of K for plants to take up. The soil solution is, however, subject to loss by leaching.

As plants take up solution K, exchangeable K takes the place of solution K, while another K ion (from nonexchangeable and structural K sources) moves into the position the exchangeable K was once using. In otherwords, these different forms of K move around (like people do in the game "musical chairs") to replace K used up by plants or to replace K that is lost in the environment.

Plants are known to take up five to ten times more K, as compared to N and P, however; plants cannot take up potassium (and other nutrients) when soil moisture and temperatures are low, when root growth is small, and when enough oxygen is not available. Like phosphorus, potassium is only available to plants in small amounts and is hard for plants to get. Like certain forms of nitrogen and phosphorus, potassium also becomes fixed onto clay particles in soil, making it even harder for plants to obtain..

WHAT HAPPENS WHEN PLANTS DON'T GET ENOUGH POTASSIUM:

Plants lacking in K do not have enough energy to properly grow, their roots are not well formed, and they have weak stems and stalks. The edges of older plant leaves appear "burned", as K deficient plants cannot regulate and use water efficiently. K deficient plants are more easily affected by pests, bugs, and diseases. Also, they cannot survive through winters or droughts (periods of time when water is not available to plants).

So, you see, plants that do not get enough of these very important nutrients, (don't forget them- they are N, P, and K!) cannot grow well and eventually can die. But we also must use our knowledge about soils to ensure that nutrients are added to soil in the right amounts and that soil is managed in ways to prevent nutrients from leaving the soil and polluting our groundwater (drinking water), streams, lakes, and rivers.

Name_____

All about Nitrogen, Phosphorous, and Potassium
(To accompany reading)

1) Why do plants like Nitrogen?

2) How does Nitrogen move through the soil?

3) How do plants take up Nitrogen?

4) What happens when plants don't get enough nitrogen?

5) What happens when plants get too much nitrogen?

6) Why do plants like phosphorus?

7) How does phosphorus move through the soil and how do plants take up phosphorus?

8) What happens when plants don't get enough phosphorus?

9) What happens when plants get too much phosphorus?

10) Why do plants like potassium?

11) How does potassium move through soil?

12) What happens when plants don't get enough potassium?

13) What happens when plants get too much potassium?

Characterizing Soil

Background:
Soil comes in a variety of shapes, colors, textures and consistencies formed by both physical and biological forces found in nature. Many of us take soil for granted but in reality soil feeds not only humans but wildlife too, and few people actually understand just how long it takes for soil to actually form and and how it forms.

Objectives:

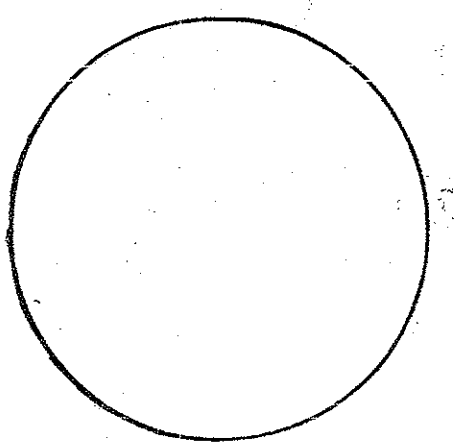
*Identify and characterize three soil types on the Komachin campus.
*Observe and examine soil types on the microscopic level.
* Connect the importance of soil and its relation to the global food web.

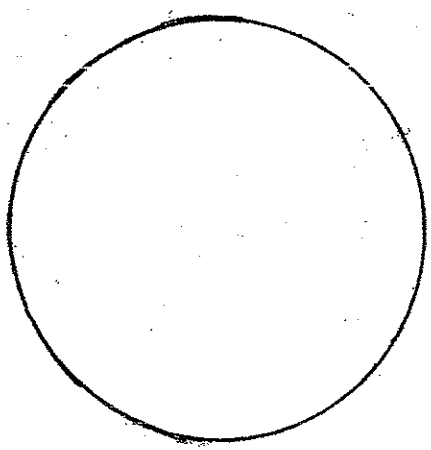
Procedures:

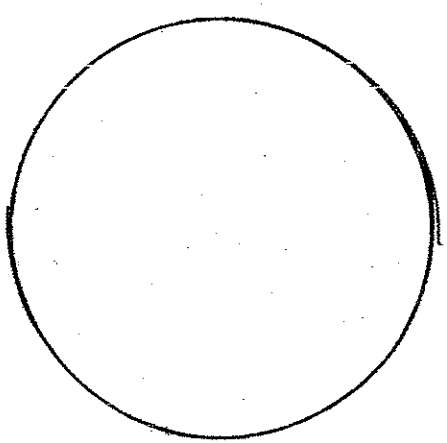
1. Hand out the soil texture, consistency, and structure field guides.
2. Hand out the student sheet for them to use in the field and in the lab for their observations and drawings.
3. Take students outside to observe three different soil types.
4. Make and record observations about the three soil types by first looking at **Soil structure. Soil structure** is the shape that the soil takes based on its physical and chemical properties. Each individual unit of soil structure is called a **ped**. Take a sample of undisturbed soil in your hand (either from the pit or from the shovel or auger). Look closely at the soil in your hand and examine its structure. Possible choices of soil structure are: **granular, blocky, prismatic, columnar, platy, massive or single grained**.
5. Make and record observations about the three soil types based on consistency, The choices are **loose, friable or firm**.
6. Make and record observations about the three soil types based on its texture. The choices for texture are **gritty** (sand) **soft, silky or "floury"** (silt), or **sticky** (clay).
7. Bring students back to the lab to allow them to make some microscopic observations with the dissecting scopes and draw how each looks under high and low power.

Soil Characterization Data Sheet **Name**_____

Sample	Structure	Color	Consistance	Texture
1				
2				
3				

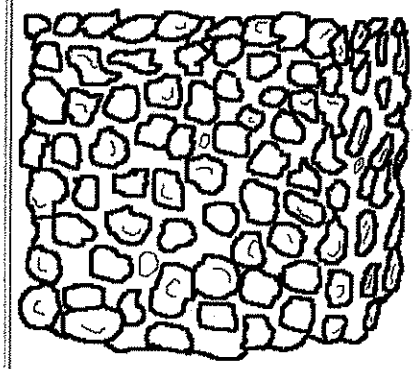
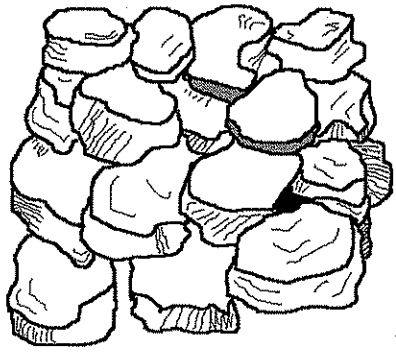
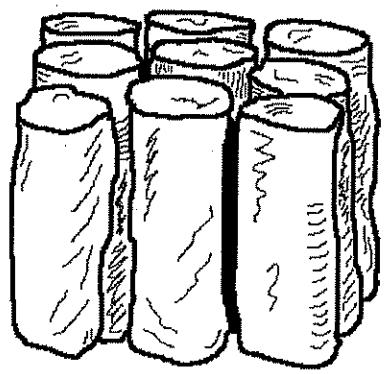
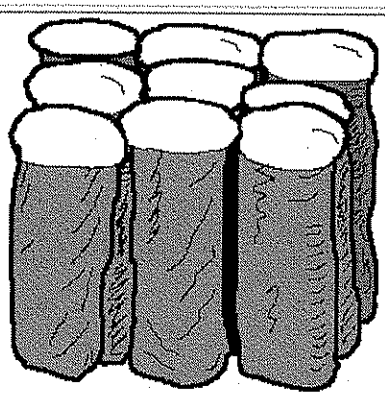
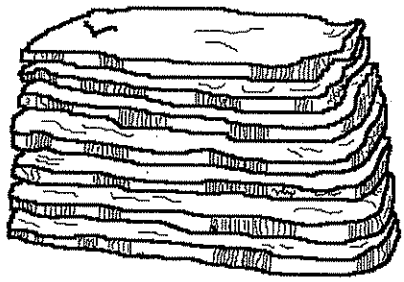
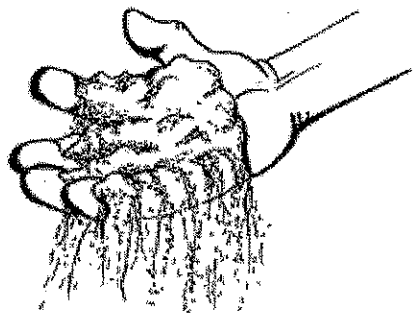






Soil Structure

Soil structure is the shape that the soil takes based on its physical and chemical properties. Each individual unit of soil structure is called a **ped**. Take a sample of undisturbed soil in your hand (either from the pit or from the shovel or auger). Look closely at the soil in your hand and examine its structure. Possible choices of soil structure are:

		
Granular: Resembles cookie crumbs and is usually less than 0.5 cm in diameter. Commonly found in surface horizons where roots have been growing.	**Blocky**: Irregular blocks that are usually 1.5 - 5.0 cm in diameter.	**Prismatic**: Vertical columns of soil that might be a number of cm long. Usually found in lower horizons.
		
Columnar: Vertical columns of soil that have a salt "cap" at the top. Found in soils of arid climates.	**Platy**: Thin, flat plates of soil that lie horizontally. Usually found in compacted soil.	**Single Grained**: Soil is broken into individual particles that do not stick together. Always accompanies a loose consistence. Commonly found in sandy soils.

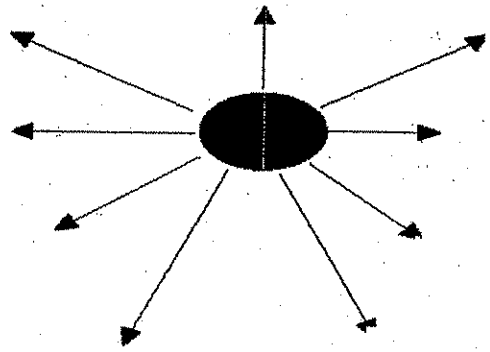
Name_____

Introducing Soil Web Search

Go to: http://soil.gsfc.nasa.gov/features.htm
to find links to the following sections. Use the web pages to answer the questions or fill in the diagrams.

Section One: What the Soil Does (The Soil is A "Jill" of All Trades)

The soil is a:



There is a limited amount of soil, and so it must be properly cared for.

- How much of the earth is covered with water? _____
- How much of the earth is covered with land?_____
- How much of the remaining land is desert, polar, or mountainous? ____
- How much land is left overall? _____
- What conditions prevent 40% of this remaining land to be productive?

_____

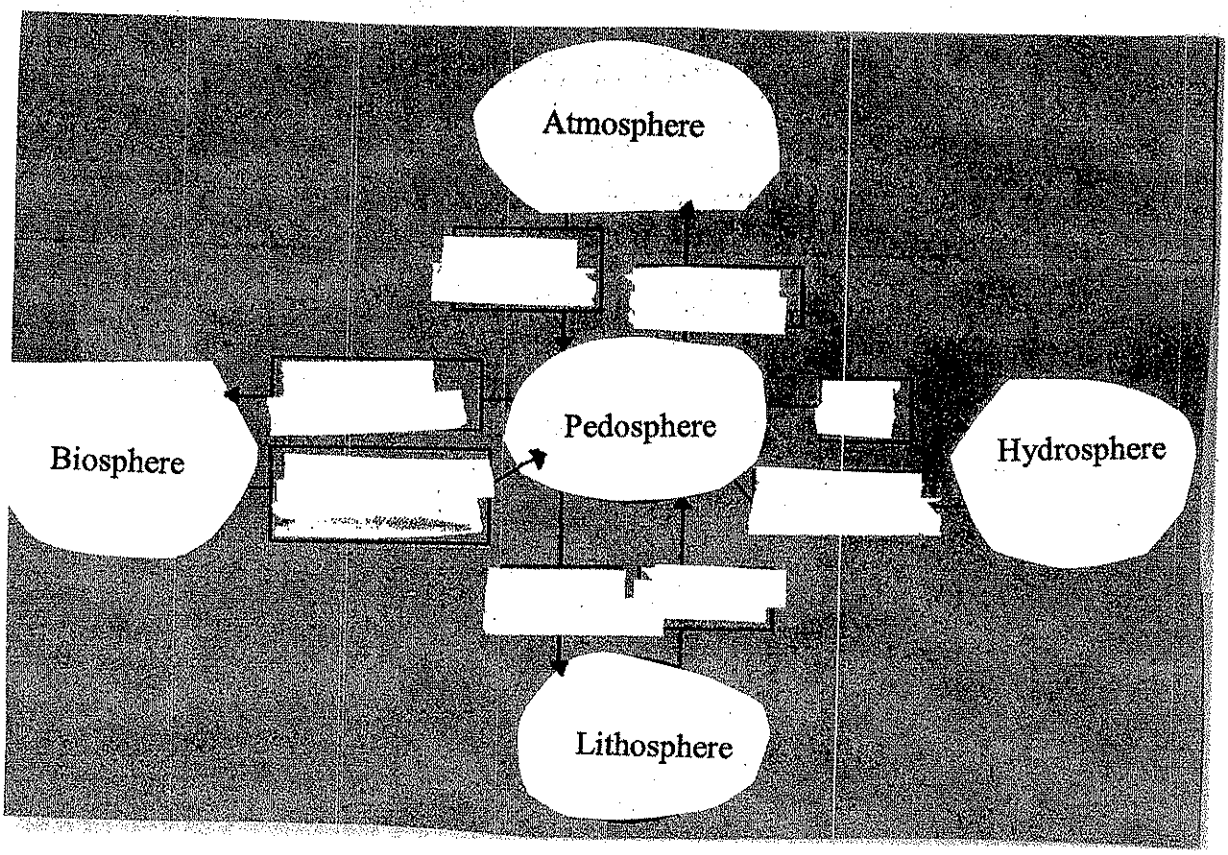
_____

- The remaining % of land left for farming is _____. What does this remaining amount have to compete with?

_____

_____

Section Three: The Pedosphere As a Hub (A Soil By Any Other Name..)



Section Four: Secrets Hidden in Soil

- What are the five forming factors that create soil?
  - _____
  - _____
  - _____
  - _____
  - _____

5) Describe the tools and techniques Forensic Geologist use to do their work.

_____

_____

_____

Name_____

Komachin Sustainable School Scavenger Hunt

You have a two sided map. On one side is an aerial photo of the whole Komachin grounds, and the other is a "Conceptual Plan" of the Komachin Education Garden drawn in June 2001.

It is expected that you and your partner do not gather with other partners in your class and that at all times you are respectful of the other classes by not being loud or purposefully disruptive.

Draw and Label (or make a key for) the following features on the aerial view of Komachin.

1. The Memorial Garden
2. Storm Drains
3. Rhododendrons
4. Deciduous Trees
5. Lacey Well-Head
6. Direction to Chambers Lake
7. College St.
8. Impervious Surfaces
9. Direction to Wonderwood
10. Grass Areas
11. Reimer's missing Azaleas
12. Evergreen Trees
13. Shrubs
14. Direction to view Mt. Rainer

Shade, Draw, and Label (or make a key for) the following features on the Conceptual Map of Komachin.

1. Green House
2. Raised Beds
3. Rain Garden
4. Central Plaza
5. Native Berms
6. Kiosk
7. Rocks
8. River
9. List Flowers/vegis
10. Proposed Bridge
11. River of Words
12. Find favorite poem and share.
13. Damaged Mural
14. How many Greenhouse Tables
15. Spiget Closest to GH
16. List How many Native Plants you can identify.

Water Quality Tests

Name:_____

Test	What it tells us	Good/Bad levels for test	Testing Group
Dissolved Oxygen			
Temperature			
pH			
Nitrate			
Turbidity			
Fecal Coliform			

Field Trip Date:
Field Trip Location:
Weather:
Site Description:

Test	Data
Dissolved Oxygen	
Temperature	
pH	
Nitrate	
Turbidity	
Fecal Coliform	

1. Analysis of water quality:

2. Suggestions for improvement:

Practice Planning a New Investigation Name:_____

In inquiry, you investigated how different variables (worms, moisture, air, compost, etc.) affected the decomposition rate of an apple. Now you get to show that you understand how to plan an investigation. You will have a new question. For this question, write a hypothesis, list materials, and write procedures for the investigation.

New Investigative question: How does the type of fruit affect the rate of decomposition?

Plan an investigation to answer the new investigative question.

In your plan, be sure to include:

- Hypothesis
- Materials needed to do the investigation
- Procedure that includes:
  - logical steps to do the investigation
  - two controlled (kept the same) variables
  - one manipulated (changed) variable
  - one responding (dependent) variable
  - how often measurements are taken and recorded

Question: How does the type of fruit affect the rate of decomposition?
Hypothesis :
Materials:

You may use the space below for a labeled diagram to support your procedure.

Procedure:

On-line Scientific Method Activity Name:_____

- Go on line and type: http://aspire.cosmic-ray.org/ in the address window.
- Click on "Scientific Method".
- Click on picture.
- Click on "What is the Scientific Method?"
- You need to use the arrow buttons to work your way through the website and answer the questions.

1. Read about the death of Terrance Bogg. Who killed him? _____
2. What is the method called for solving problems for both a detective and a scientist? _____
3. Answer questions for Lab1: _____ _____
4. Where you right? _____
5. What's the difference between an opinion and a fact?

   _____

   _____
6. What is an inference?

   _____

   _____
7. Identify as fact or inference:

   _____

   _____

   _____

   _____

   Were you right?

   Try some more!
8. Write a hypothesis for situation #3:

   _____

   _____
9. What was Pasteur's correct hypothesis?

   _____

   _____
10. What was the Greek's incorrect hypothesis?

    _____

    _____
11. Write a hypothesis about the water quality situation:

    _____

    _____
12. What does "valid" mean": _____
13. What's wrong with experiment #1? _____
14. What's wrong with experiment #2? _____
15. What's wrong with experiment #3? _____
16. What is a scientific theory?

    _____

    _____

Scientific Method Review

Question

- This is the focus of your whole investigation
- The question must be testable!!!!
- The question should include the manipulated and responding variables

Background Information

- This is any useful information that might make your hypothesis more accurate or will allow you to understand the investigation more clearly
- This information might come from class discussion, textbook reading, computer research, etc.

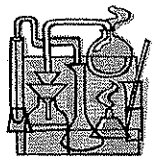
Hypothesis

- If...(manipulated variable)...
- Then...(responding variable)...
- Because...(you don't have to be right to get credit, but it does have to be reasonable)

- Your hypothesis is your best educated guess before starting an investigation
- It's the prediction of what's going to happen

Materials

- All the stuff needed to perform an investigation
- Materials list and procedures should match
- Always be sure to include a measuring devise for the responding variable
- You don't have to be specific about your amounts in the materials list, but you do have to be specific in your procedures



Procedures

- Must be logical/repeatable
- Write in a numbered list
- At least 1 controlled variable (kept same)
- Only 1 manipulated (changed) variable
- Only 1 responding (measured) variable
- Must include "record measurements", be specific about what's to be measured ("measure plant size not specific" "measure height of plant" is)
- If steps are to be repeated, be careful! Make sure you are saying to repeat the right steps!
- Include how much of things to use and how long to perform actions
- To make investigation more valid, include repeated trials
- Avoid pronouns, especially "it"

Attributes of a Controlled Investigation for Awarding Value Points

Investigation Attributes	Description of Attribute	Value point
Prediction	The prediction portion of the hypothesis must answer the given question including the effect of the manipulated (changed) variable on the responding (dependent) variable.	1
Prediction Reason	A hypothesis must give a related reason for the prediction.	1
Materials	A list of the minimum materials needed to perform the procedure, including s tool to measure responding variable. Attribute Notes: 1. The 'right' amount of ingredients (e.g. 'x' mL or 'y' grams) needed to carry out the procedure do not need to be given in the material list. 2. If pre-measured amounts of materials are listed in the materials list, a measuring device may not be needed in the materials list. 3. Standard Classroom Materials do not need to be listed: paper, pencil, safety equipment (e.g. goggles, aprons, gloves, tongs).	1

Attributes of a Controlled Investigation for Awarding Value Points (continued)

Investigation Attributes	Description of Attribute	Value Point
Procedure:	The written or diagrammed procedure is evaluated as follows.	Up to 6
Controlled (kept the same) Variable	At least one controlled (kept the same) variable must be identified or implied in the procedure or the materials list	1
Manipulated (changed) Variable	Only one manipulated (changed) variable is identified or implied in the procedure or data table (if given).	1
Responding (dependent) Variable	The responding (dependent) variable is identified or implied in the procedure or data table (if given).	1
Record Measurements	The procedure states or implies measurements are recorded periodically or gives a data table. Attribute Note: 1. If artificial data for the responding variable is given, no value point may be awarded. 2. The phrase 'take measurement' cannot be used to mean record.	1
Trials are Repeated	More than one trial for all conditions is planned, or implied in a data table, to measure the responding (dependent) variable.	1
Logical Steps	The steps of the procedure are detailed enough to repeat the procedure effectively (examples of illogical steps: no ending time indicated, states "Set up as diagrammed" but diagram is inadequate, recording vague data or results).	1
	Total Value Points Possible	9

Performance Description	Value Points
A **4-point response** demonstrates that the student has understanding of the GLE: IN02 Understand how to plan and conduct scientific investigations.	8-9
A **3-point response** demonstrates that the student partially understands the GLE.	6-7
A **2-point response** demonstrates that the student has limited understanding of the GLE.	4-5
A **1-point response** demonstrates that the student has very little understanding of the GLE.	2-3
A **0-point response** demonstrates that the student has almost no understanding of the GLE.	0-1

Controlled Variables

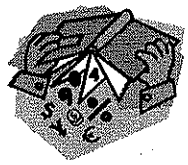
- These are the things you do in your investigation to make sure that it is fair and repeatable!
- These are the things you do the same throughout the investigation!
- These are the things you do to make sure you are only manipulating one variable!

Manipulated Variable

- This is the thing you are testing in your investigation.
- It is the thing you are intentionally changing.
- There can only be one manipulated variable in an investigation.

Responding Variable

- This is what you are observing and making measurements about in your investigation.
- It is the response (or lack of response) to what ever it is you chose to manipulate.
- It is the variable that you are recording information about in your data table.



Data

- Never make up data when designing an investigation for a test
- Data is what you observe during an investigation (observations)
- May be descriptive: qualitative
- May be measurement: quantitative
- A data table is used to keep data organized

Analysis

- This is where you think about the data and ask yourself:
  - Was the hypothesis correct?
  - What is the relationship between the manipulated and responding variable?
  - What was learned in this investigation?
- Charts and graphs help with this step
- You might not have to actually write anything down, but your thinking will be shown in your conclusion

Conclusion

- **Question:** Restate the question
- Prediction: Restate the hypothesis
- Evidence: Report data
  - Range of high and low/any important numbers
- Answer: State if data supported or didn't support hypothesis
- Conclude: concluding statement explaining what the experiment showed

• Avoid Pronouns!
(It, you, me, I, we)

Conclusion Example

Plant Growth Data

Plant	Start height	Week 1	Week 2	Week 3	Total Growth
Plant 1 no fertilizer	12 cm	14 cm	15 cm	16 cm	4 cm
Plant 2 5 ml fertilizer	14 cm	16 cm	18 cm	19 cm	5 cm
Plant 3 10 ml fertilizer	10 cm	13 cm	15 cm	17 cm	7 cm

Example Conclusion

This investigation was exploring the affect of fertilizer on plant growth. Before starting, it was predicted that adding fertilizer to a plant's water will make the plant grow taller because fertilizers provide plants with necessary nutrients. After 3 weeks, the plant with no fertilizer added grew a total of only 4 centimeters. The plant with the most fertilizer added, 10 milliliters, grew a total of 7 centimeters. The data clearly supports the original hypothesis. The experiment showed that adding fertilizer to a plant's water will make the plant grow taller.

Questions?

Inquiry Formal Lab Write-Up Assignment Name:_____

1. Choose one of the inquiry labs we have done in this class to formally write-up and present to the class. (Apple to Soil Lab, Wigglin' Worms, Seed Germination Lab)

2. You may either work independently or with one other student.

3. Use your original lab sheets to make a powerpoint of the steps you went through in the lab. Each of the following steps should be a separate slide in your powerpoint.
    a. Introduction: Your name/names and name of lab
    b. Question
    c. Background information (at least 3 relevant pieces of information)
    d. Hypothesis
    e. Materials
    f. Variables (manipulated, responding, and 3 controlled)
    g. Procedures
    h. Data Table
    i. Conclusion

4. You will be graded on your understanding of these steps as well as the quality of your powerpoint and presentation.

5. Hints:
    a. Do not spend all your time picking out background colors and clip-art. Get the information in your powerpoint first and then worry about all the "bells and whistles".
    b. Be thoughtful about the color and size of the writing you use. Will your audience be able to read it during your presentation?
    c. Be careful about saving your powerpoint, make sure it gets into your student folder.
    d. If working with a partner, you could split up the slides and then have your teacher merge them into a single powerpoint.
    e. If you work with a partner, you will both get the same grade, so choose wisely!

Scoring Rubric
Inquiry Formal Lab Write-Up Assignment

	Description	Points Possible	Points Earned
Scientific Method			
Introduction	Name of lab and scientists	2	
Question	What you were investigating	2	
Background info	3 relevant pieces of information about your topic	5	
Hypothesis	"If, then, because"	3	
Materials	Everything you used	5	
Variables	Manipulated, responding, and 3 controlled	5	
Procedures	Logical, step by step, includes what to measure and how often	6	
Data table	Complete and organized	5	
Conclusion	Restate question, restate hypothesis, discuss data, say if hypothesis was correct, say what was learned in experiment	7	
Quality of Powerpoint	clip art is relevant, writing is readable in both size and color, the slides are clear without too much distraction	10	
Presentation	organized, not reading straight from powerpoint, loud and clear voice	10	
Final Grade:		60	
Comments:			

Hawk's Prairie Waste and Recovery Center

Field Trip Background Worksheet Name:_____

1. Vocabulary

Landfill

Dump

Compost

Solid Waste

Leachate

Landfill gas

Stormwater

Incinerate

2. Path your garbage takes

1.

2.

3.

4.

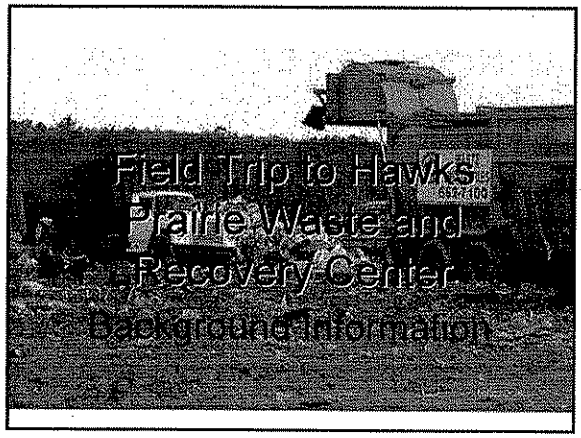
5.

6.

7.

8.

Problem	Solutions
Containing Trash so it doesn't impact the environment	
Limited Space	
Keeping landfill dry	
Leachate	
Landfill Gas	



You have just finished your meal at a fast food restaurant and you throw your uneaten food, food wrappers, drink cup, utensils and napkins into the trash can. You don't think about that waste again. On trash pickup day in your neighborhood, you push your can out to the curb, and workers dump the contents into a big truck and haul it away. You don't have to think about that waste again, either. But maybe you have wondered, as you watch the trash truck pull away, just where that garbage ends up.

Garbage Trivia

- The average American throws away 3.5 pounds of trash a day.
- To give you an idea of how much trash we generate here in the United States, imagine a hole the size of a football field, including the end zones. If we bury all of the trash we produce in just one year, that hole would be 100 miles deep!
- Every year we fill enough garbage trucks to form a line that would stretch from the earth, halfway to the moon.
- Each day the United States throws away enough trash to fill 63,000 garbage trucks.
- Almost 1/3 of the waste generated in America is packaging.
- In 1995 27% of the United States' food supply spoiled or went unused (48,000,000 tons).
- Man-made rubbish in orbit includes 8,500 objects and 100,000 pieces of space litter.

Shopping Trivia

- Americans buy 2,300,000 pairs of shoes a day - enough to cover the bottom of a 17-acre closet with shoe boxes.
- Every year Americans buy more than a billion incandescent light bulbs. That is three acres of light bulbs a day. A 60-watt incandescent light bulb will last about 750 hours, compared to 7,500 to 10,000 hours that a compact fluorescent bulb that generates the same light.
- An average child will use between 8 -10,000 disposable diapers ($2,000 worth) before being potty trained. Each year parents and babysitters dispose of about 18 billion of these items. In the United States alone these single-use items consume nearly 100,000 tons of plastic and 800,000 tons of tree pulp. We will pay an average of $350 million annually to deal with their disposal and, to top it off, these diapers will still be in the landfill 300 years from now.
- Americans throw away 570 diapers per second. That's 49 million diapers per day.
- Seventy-six percent of Americans consider themselves environmentalists.
- If more people became environmental shoppers, the amount of trash could be reduced by as much as 45 percent.

Vocabulary

- Landfill
- Dump
- Compost
- Solid Waste
- Leachate
- Landfill gas
- Stormwater
- Incinerate

Landfill

- carefully designed structure built into or on top of the ground in which trash is isolated from the surrounding environment (groundwater, air, rain). This isolation is accomplished with a bottom liner and daily covering of soil.

- The purpose of a landfill is to bury the trash in such a way that it will be isolated from groundwater, will be kept dry and will not be in contact with air. Under these conditions, trash will not decompose much. A landfill is not like a **compost** pile, where the purpose is to bury trash in such a way that it will decompose quickly.

Dump

- an open hole in the ground where trash is buried and that has various animals (rats, mice, birds) swarming around. (This is most people's idea of a landfill!)

Compost

- The purpose of a landfill is to bury the trash in such a way that it will be isolated from groundwater, will be kept dry and will not be in contact with air.
- Under these conditions, trash will not decompose much.
- A landfill is not like a **compost** pile, where the purpose is to bury trash in such a way that it will decompose quickly.

Solid Waste

- Fancy name for trash
- 210 million tons is generated in the United States annually
- about 27 percent is either recycled (glass, paper products, plastic, metals) or composted (yard waste)
- The remaining trash is discarded and is made up of mostly paper products, plastics, yard waste and wood

Leachate

- The water percolates through the cells and soil in the landfill much as water percolates through ground coffee in a drip coffee maker.
- As the water percolates through the trash, it picks up contaminants (organic and inorganic chemicals, metals, biological waste products of decomposition) just as water picks up coffee in the coffee maker.
- This water with the dissolved contaminants is called **leachate** and is typically acidic.

Landfill Gas

- contains approximately 50 percent methane and 50 percent carbon dioxide with small amounts of nitrogen and oxygen.
- Produced from anaerobic breakdown of trash

Stormwater

- Water from rainfall
- Needs to be kept separate from trash in landfill

Incinerate

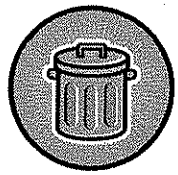
- An alternative to a landfill
- Trash is burned at a very high temperature

Do you know what happens to your trash when it you throw it away at Komachin?

Guess!

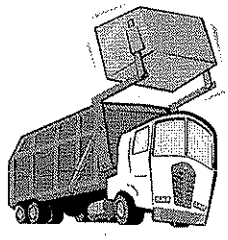
Try and think of all the steps before it ends up in a landfill

1. Your garbage sits in the trash can until after school.



2. Your trash gets picked up by a custodian and hauled out to the dumpster after school.

3. Your trash sits in the school dumpster until the dump truck hauls it away.

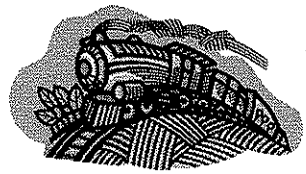


4. The garbage truck hauls your garbage to Hawks Prairie Waste and Recovery Center

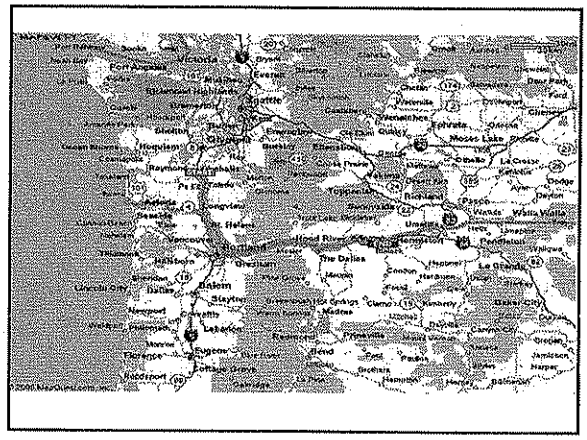
5. At Hawk's Prairie, your garbage is dumped and sorted by a bulldozer and people picking through the trash. They try and recover recyclable items.

6. Your garbage does not stay here! Hawks Prairie is a closed landfill. Your trash is compacted and trucked to Chehalis.

7. In Chehalis, your garbage is put on a train.



8. The train goes all the way south to the Columbia River and then East to Roosevelt Regional Landfill, 216 miles away where it is dumped.



Roosevelt Regional Landfill

- The largest private landfill in the state, Roosevelt covers an area of 2,545-acres, has a 120 million ton capacity, and a 40 year expected trash-receiving life. Trash comes in shipping containers, mostly via rail from the Seattle area, to an intermodal yard in Roosevelt. Containers are loaded onto trucks for the haul up the hill to the landfill, and then emptied by tilting lifts that upend the container/trailer assembly. Trash also arrives from a network of nine intermodal yards that connect the landfill to sources as far away as California. Trash also comes from Alaska on barges. Empty trash trains take fruit and other goods from eastern Washington back to Seattle (in different containers).

Problems with Landfills

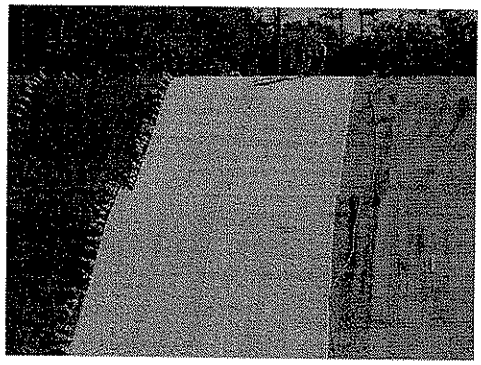
1. Containing Trash so it doesn't impact the environment
2. Limited Space
3. Keeping landfill dry
4. Leachate
5. Landfill Gas

Containing Trash so it doesn't impact the environment

- A landfill's major purpose and one of its biggest challenges is to contain the trash so that the trash doesn't cause problems in the environment. The **bottom liner prevents the trash from coming in contact with the outside soil, particularly the groundwater.**

At Hawk's Prairie:

- HazoHouse area collects household hazardous to keep them out of the landfill



Limited Space

- The amount of space is directly related to the capacity and usable life of the landfill.
- trash is compacted into areas, called **cells**, that contain only one day's trash
- space is conserved by excluding bulky materials, such as carpets, mattresses, foam and yard waste, from the landfill

At Hawk's Prairie:

- Yard waste is composted
- Recycling bins are available
- A Goodwill Industries collection center is

Keeping landfill dry

- **Exclude liquids from the solid waste.**
- **Keep rainwater out of the landfill.** To exclude rainwater, the landfill has a storm drainage system. Plastic drainage pipes and storm liners collect water from areas of the landfill and channel it to drainage ditches surrounding the landfill's base. The ditches carry water to collection ponds to the side of the landfill.

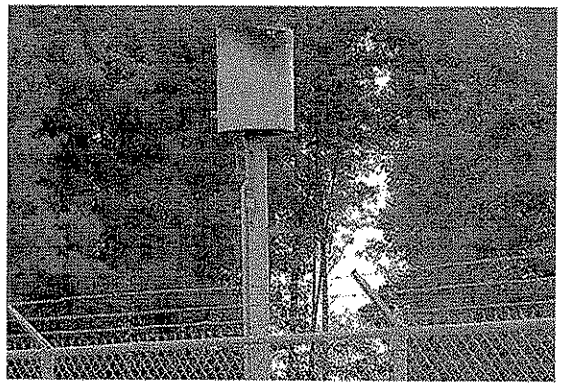
Leachate

- To collect leachate, perforated pipes run throughout the landfill and drain into a leachate collection pond.
- The leachate in the pond is tested for acceptable levels of various chemicals and allowed to settle. After testing, the leachate must be treated like any other sewage/wastewater; the treatment may occur on-site or off-site. At Hawk's Prairie, treatment takes place off-site at LOTT.

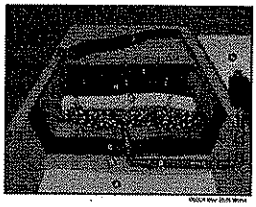
- **A leachate collection pond is designed to catch the contaminants that can get into water that goes through the trash in a landfill.**

Landfill Gas

- Bacteria in the landfill break down the trash in the absence of oxygen **(anaerobic)** because the landfill is airtight. A byproduct of this anaerobic breakdown is landfill gas, which contains approximately 50 percent methane and 50 percent carbon dioxide with small amounts of nitrogen and oxygen. This presents a hazard because the methane can explode and/or burn. So, the landfill gas must be removed. To do this, a series of pipes are embedded within the landfill to collect the gas. In some landfills, this gas is vented or burned.
- More recently, it has been recognized that this landfill gas represents a usable energy source. The methane can be extracted from the gas and used as fuel.

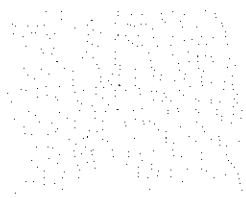


Parts of a Landfill



A Ground Water
B Compacted Clay
C Plastic Liner
D Leachate Collection Pipe
E Geotextile Mat
F Gravel
G Drainage Layer
H Soil Layer
I Old Cells
J New Cells
K Leachate Pond

Figure 3. This cross-section drawing shows the structure of a municipal solid waste landfill. The arrows indicate the flow of leachate.



Thurston County Solid Waste School Programs

Performing a School Waste Audit

The purpose of conducting a waste audit is to determine what is in the waste stream, and in what amounts. This is useful for baseline information before you start a recycling program, to measure the success of a current recycling program, and/or to find out how a recycling program can be improved. A waste audit is also very useful for promoting awareness about solid waste and waste reduction, and has been used as part of a waste reduction/recycling curriculum in schools, both locally and nationally.

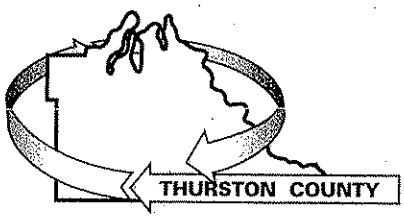
A waste audit involves taking a random sample of garbage from the school and sorting it into a variety of categories. As you can imagine, waste audits are messy, which makes them memorable! But while they are messy, proper safety precautions and procedures keep participants safe.

The audit will show students the quantity of their waste at school that is recyclable, reusable, and compostable. We look at the weight and volume of the materials currently disposed. Schools typically generate a high volume of paper and food. We also look at the sources of the waste. We determine where the waste is being generated and if the material can be:

- **reduced** (e.g. make 2 sided copies)
- **reused** (e.g. reuse packing material)
- **recycled** (e.g. collect and recycle office paper).

The results of the waste audit tell us just what is being thrown away so we can then determine how to make less waste. A good recycling and waste reduction program will reduce waste collection costs and conserve natural resources. This is a win-win solution for the school and for the students.

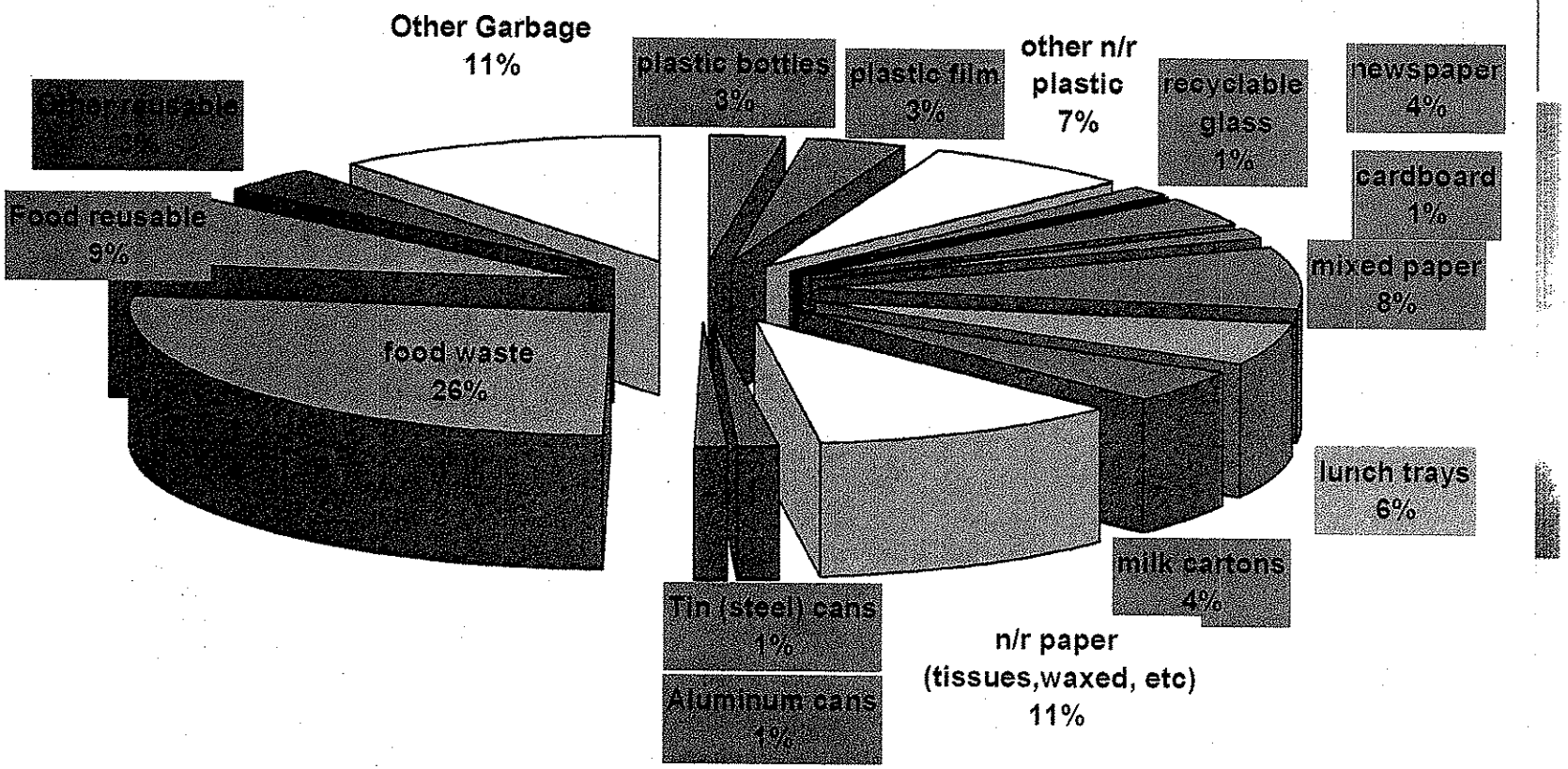
- Thurston County Solid Waste Educators



Thurston County Solid Waste 921 Lakeridge Drive SW Olympia, WA 98502
786-5494 www.co.thurston.wa.us/wwm

Komachin Waste Analysis

Recyclable Compostable Disposal



Komachin Classroom Garbage Audit Report

Recycle Report For:_____
Room:_____
Date:_____
Prepared By:_____

	Practice Sort		Classroom bin		Whole House
	Tally	Total	Tally	Total	total
Paper					
Cardboard					
Plastic bottle					
Aluminum can					
"garbage"					
Total Items	XXXXXX		XXXXXXXX		

Report for your classroom:

1. Total Number of items found in trash:
2. Number of Items that were garbage:
3. Number of Items that could have been recycled at Komachin:

4. Percentage that was garbage
   total garbage ÷ total items
   _____ ÷ _____ =

5. Percentage that was recyclable
   total (paper +cardboard + aluminum + plastic) ÷ total items
   (_____ + _____ + _____ + _____) ÷ _____

6. Percentage Grade:
7. Letter Grade:

Report for the House:

1. Total Number of items found in trash:
2. Number of Items that were garbage:
3. Number of Items that could have been recycled at Komachin:

4. Percentage that was garbage:
5. Percentage that was recyclable:

6. Percentage Grade:
7. Letter Grade:

Reflection Questions:

1. How did the classroom garbage compared to the house garbage:

2. Did you find anything in the garbage that you thought was still usable?

3. Was there any wasted food in the garbage?

4. What was the strangest thing anyone found?

5. Advice/recommendations you would give to the teacher and their students to recycle better.

Recycling Trivia

General Information

The United States produces approximately 220 million tons of garbage each year according to the Environmental Protection Agency. This is equivalent to burying over 82,000 football fields six feet deep in compacted garbage.

Aluminum Facts

One ton of recycled aluminum saves 14,000 Kwh of energy, 40 barrels (1,663 gallons) of oil, 238 million Btu's of energy and 10 cubic yards of landfill space.

Recycling aluminum takes 95% less energy than making aluminum from raw materials.

Each aluminum can recycled saves enough electricity to light a 100 watt bulb for 3.5 hours.

Two out of three aluminum cans are recycled in the United States each year.

Aluminum cans and aluminum scrap are recycled into new aluminum products including airplanes, cars, and more soda cans.

Corrugated Container Facts

One ton of recycled corrugated containers saves 390 Kwh of energy, 1.1 barrels (46 gallons) of oil, 6.6 million Btu's of energy, and 6.6 cubic yards of landfill space.

The majority of corrugated containers that are recycled are manufactured into more corrugated containers.

Paper Facts

One ton of recycled office paper saves 4,100 Kwh of energy, 9 barrels (380 gallons) of oil, 54 million Btu's of energy, 60 pounds of air pollutants from being released, 7,000 gallons of water, and 3.3 cubic yards of landfill space..

Around 4.5 million tons of office paper is thrown away each year in the United States. This is enough paper to build a 12 foot high wall of paper from Los Angeles to New York City.

Annually each person in the United States use paper equivalent to 2 pine trees.

Newsprint is recycled into newspapers, paper egg cartons, cereal boxes, cellulose insulation and acoustical ceiling tiles.

Plastics Facts

One ton of recycled plastic saves 5,774 Kwh of energy, 16.3 barrels (685 gallons) of oil, 98 million Btu's of energy, and 30 cubic yards of landfill space.

Approximately 88% of the energy is saved by producing plastic from plastic as opposed to plastic from the raw materials of oil and gas.

The United States goes through 2.5 million plastic bottles every hour and only a small percentage is recycled.

Enough plastic bottles are thrown away each year in the United States to circle the earth four times.

Plastic containers are recycled into plastic lumber for picnic tables and park benches, carpet fiber, clothing, automotive parts, paint brushes, and more plastic bottles.

Recycling Brochure Activity Name:_____

The last activity in Inquiry is to produce a brochure for the teacher who's recycling you've been collecting all quarter. The purpose is to report back the information you gathered from the garbage audit and to share some of the information you have learned in this class. Follow the template given. You will be graded on how well you follow directions and how professional your brochure looks. The brochure will be given to the teacher. If you want to earn a service hour, you can arrange to present your brochure to the class, have the teacher sign the brochure, and return it to your Inquiry teacher.

Brochure Layout:

Page 5	Page 6	Page 1
Why Recycle?: Pick 5 facts that you find most interesting from the sheet you have, make sure you have one from each category	Thank You: • Tell the teacher what a pleasure it has been to recycle for them and wish them luck in their future recycling! Teacher Signature for classroom presentation;_____	• Title: Recycling Brochure • Teacher's name • Your Name • Clip Art

Front

Page 2	Page 3	Page 4
Recycling At Komachin: • Remind the teacher what's recyclable here at school and how to sort out recycling	Garbage Audit • What grade did they earn? • How did they compare to House? • How could they improve?	What happens to Komachin's Garbage: • List the 8 steps of the path Komachin's garbage takes to go from here to the landfill

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YOUTH GARDENING

Dirt Cake

Dirt Cake is a great treat for children and those young at heart.

You will need:

package of Oreo cookies or chocolate cookies that will crumble easily
package of gummy worms
1 box instant vanilla pudding
1 box instant chocolate pudding
mini-marshmallows or jelly beans.

Place the vanilla pudding into a one quart plastic Zip Lock bag. Add milk and then let the children and adults gently knead the bag. Make sure all the dry pudding is incorporated into the milk. Knead until pudding is thick. Do the same with the chocolate pudding. Cut the end of a corner of the bag off to use like a pastry bag to "squirt" the pudding into the cups.

Open a bag of cookies and with a rolling pin crush the cookies until they are fine crumbs. Use a brown bag or clean paper to crush the cookies.

Use a small cup, plastic or Styrofoam as your container. Place a spoon full of crumbs into the cup and add in layers: one gummy worm; teaspoon or squirt of vanilla pudding (looks like sandy soil or clay); one or two marshmallows (for rocks) or small jelly beans; more crumbs; chocolate pudding (for mud);more crumbs and top off with a gummy worm hanging over the side of the cup.

The fun is explaining to your audience the different kinds of soil and what we find in it. Of course WORMS are the big items to be discussed and that is fun! Now we get to eat dirt and worms. ENJOY!

Shop Smart

Product	Your Choice	Reason

Analysis:

1. Why were some products harder to make the "green" choice with?

2. What was the most important factor to you when deciding on a product?

3. Do you think you could influence your parents to make "greener choices when they shop?

FACTS

The United states produces approximately 220 million tons of garbage each year according to the environmental protection agency. This is equivalent to burying over 82,000 football field six feet deep with compacted garbage.

Recycling aluminum takes 95% less energy than making aluminum from raw materials.

The Majority of corrugated containers that are recycled are manufactured into more corrugated containers.

Annually each person in the United States use paper equivalent to 2 Pine Trees.

Enough Plastic bottles are thrown away each year in the US to circle the earth 4 times.

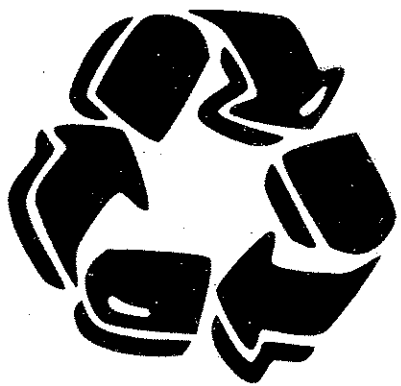
Thank You

Mrs. Leonard, for letting me recycle with your class, I hope you continue your good work as an excellent recycling classroom And keep our Future Clean!

Teacher signature*

RECYCLING BROCHURE

Mrs. Leonard



Nick Barr

Science Inquiry Period 2

Recycling at Komachin

What is recyclable at Komachin?

-Plain Paper

-Mixed paper

-Plastic bottles

-Aluminum Cans

-Corrugated Cardboard

How to Sort?

Mixed paper– Any colored or extreme written on paper.

Plain paper– Plain white paper that has one Plain side.

Plastic Bottles– Any plastic bottle in which the cap is not wider than the base.

Aluminum– Any marked Aluminum

GARBAGE AUDIT:

- **Ms. Leonard's class earned a 17.5 % Recyclables in garbage Rating, which is about a B on the grading Chart.**
- **Ms. Leonard's classroom is the cleanest recycling classroom in half of House 1.**

They Could improve by Not wasting as much food and drink items, such as drinking all of the milk before they throw it away. But overall Ms. Leonard's class room is the cleanest.

WHERE DOES YOUR GARBAGE GO?

Your garbage sits in the trash can until after school.

Your trash gets picked up by a custodian and hauled out to the dumpster after school.

Your trash sits in the school dumpster until th dump truck hauls it away.

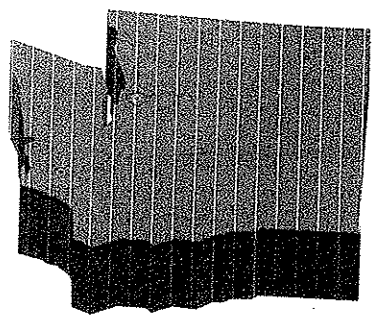
The garbage truck hauls your garbage to H Prairie Waste and Recovery Center

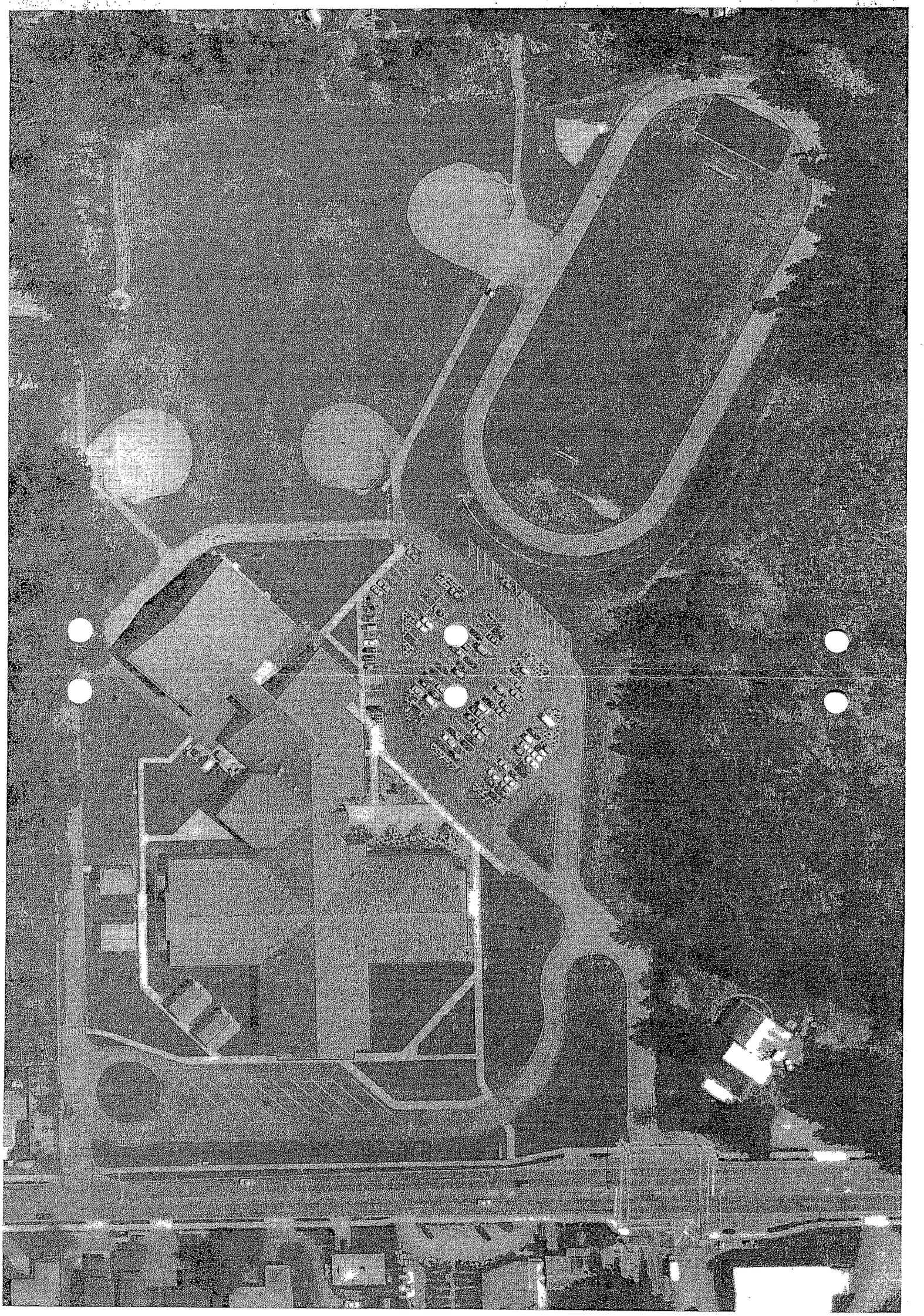
At Hawk's Prairie, your garbage is dumped a sorted by a bulldozer and people picking thro the trash. They try and recover recyclable iter

Your garbage does not stay here! Hawks Prai a closed landfill. Your trash is compacted anc trucked to Chehalis.

In Chehalis, your garbage is put on a train.

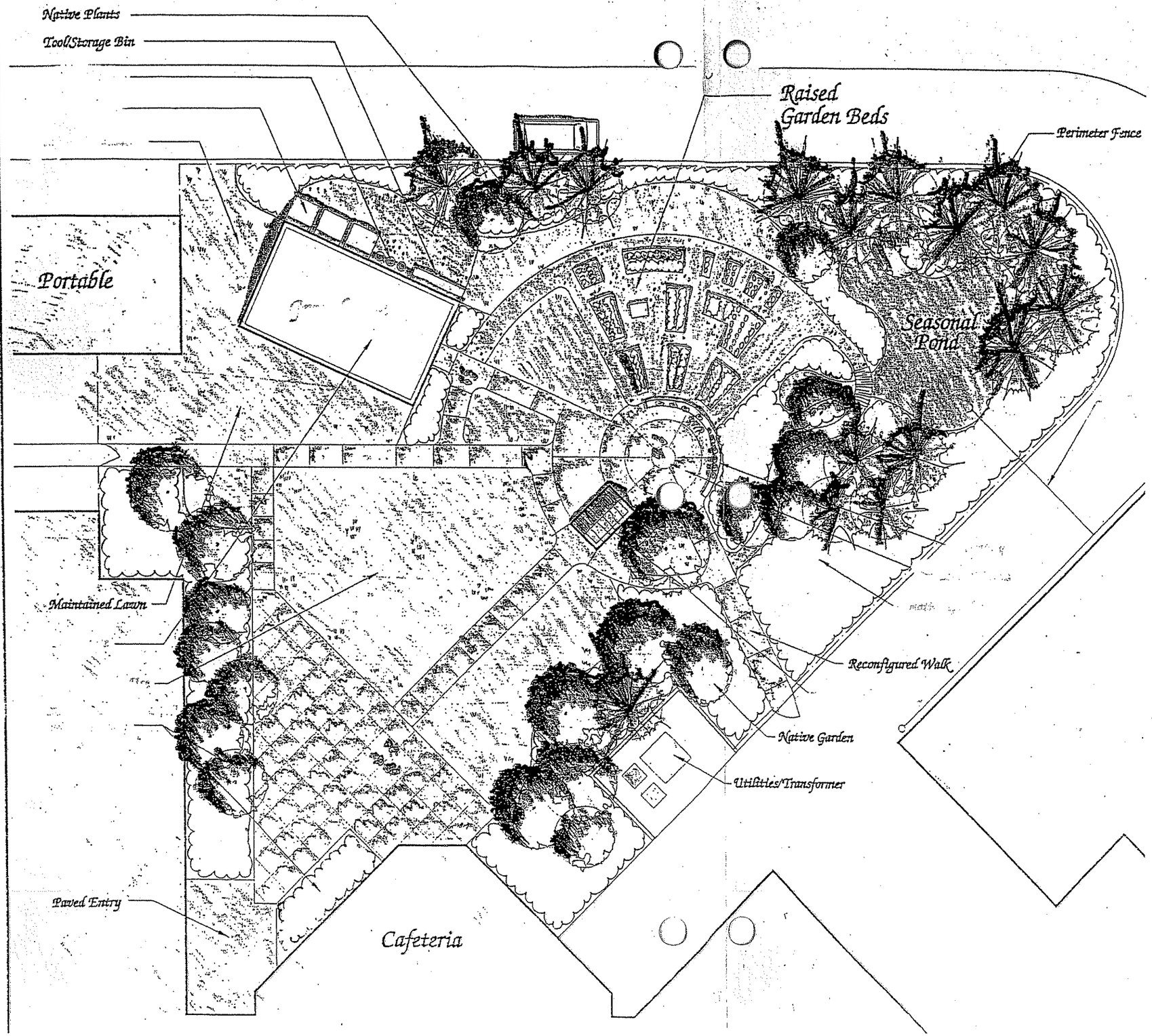
The train goes all the way south to the Colum River and then East to Roosevelt Regional La fill, 216 miles away where it is dumped.





Komachin Education Garden

Conceptual Plan



0 5' 10' 20' 40'

June, 2001